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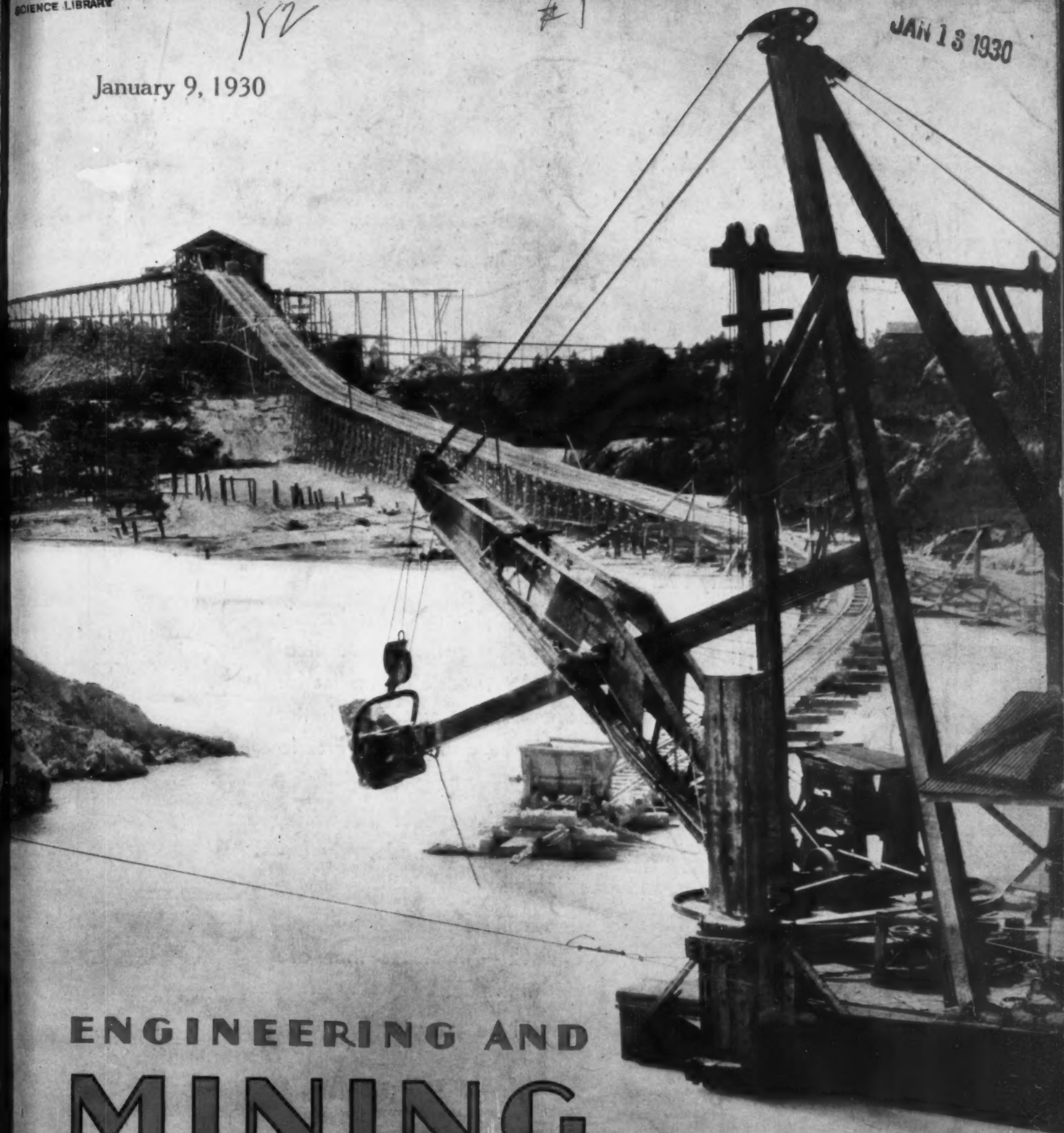
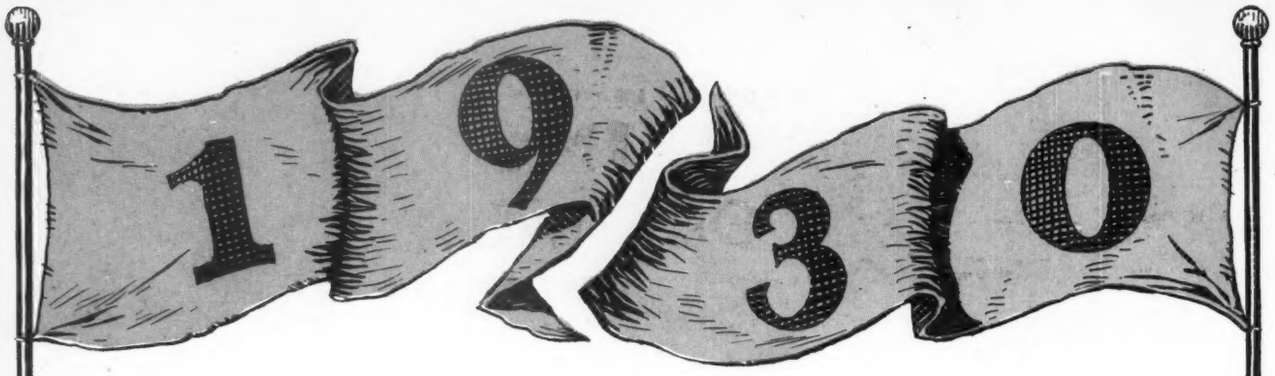


ENGINEERING AND MINING JOURNAL

A McGRAW-HILL PUBLICATION

Phosphate Mining In Southern Florida



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Index to

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1930

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Contents for January 9, 1930

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VOLUME 129 . . . NUMBER 1

Editorial 1

Power for Mine and Mill 2
PHILLIPS B. TARTT

New Nichols Copper Refinery 5
EDWARD H. ROBIE

Platinum in the Transvaal 11
DR. GEORGE F. KUNZ

Progress in Cyaniding and Ore Dressing 13
ALFRED JAMES

Mining Bank of Chile 17
FERNANDO BENITEZ

Constructing a Small Mill in China 19
EDWIN A. SPERRY

Metal Mining in Canada 22
A. H. A. ROBINSON

Electrified Haulage at Utah Copper 26
GAIL MARTIN

Mine Ventilation Chart 30
SYDNEY C. MIFFLEN

Sintering Machine Igniter 31
A. F. BEASLEY

Africa—A Land of Opportunity 32

Cover photograph by Ewing Galloway, New York

Fuse Cutter 18
Drill Sharpener Safety Device 21
Pump Suction Strainer 25
Cutting Worm-Gear Teeth 29
The Motor Starter 29
Estimating Low Acid Content 31
Compressed Air Supply 33
Glass for Launder Lining 33
Comment and Criticism 34
Book Reviews 36
Digest Current Literature 37
Personal Notes 39
Industrial Progress 40
Mining News 42
Cables 48
Market and Financial News 50
Metal Statistics 53
Stocks 54
Searchlight Section 68
Advertising Index 72

The February 8 Number will contain the Annual International Review of the Mining Industries

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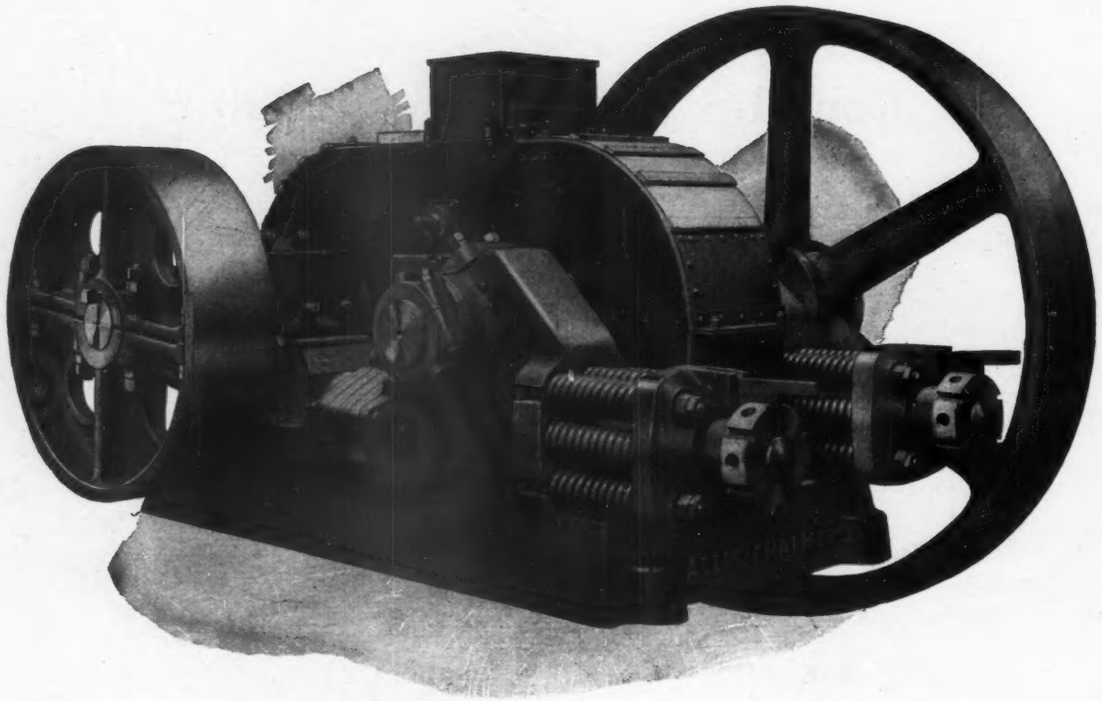

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ENGINEERING AND
MINING JOURNAL

A McGRAW-HILL PUBLICATION
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VOLUME 129, NUMBER 1

New York, January 9, 1930

EDITORIAL

WITH this issue, *Engineering and Mining Journal* becomes a semi-monthly publication, with a more comprehensive coverage of technical progress in the domestic and foreign fields. To meet the conditions and problems involved by a phenomenal expansion of circulation overseas in recent years, a new monthy magazine, *Engineering and Mining World,* has been founded, the first issue of which also appears this month. It will penetrate into every important mining region outside the United States.

A NEW publication, *Metal and Mineral Markets,* a weekly review of price trends and market tendencies in the field covered by *Engineering and Mining Journal,* with the prestige and authority of *E.&M.J.* quotations, made its début on January 2, to serve the buyer and the user as well as the producer and the seller of metals and non-metallic minerals and ores. Conditions demanded the general release of this vital information earlier than was possible when it formed part of *Engineering and Mining Journal.* The facilities of the McGraw-Hill Publishing Company were therefore put to the test, with the result that essential market information is now made available on the morning after the close of the market—forty-eight hours earlier than has been possible heretofore. This innovation, providing a more efficient service at a greatly reduced charge to the subscriber, permits more care and attention to the selection and preparation of a record of technical and engineering progress, for which *Engineering and Mining Journal* has been responsible for sixty-four years.

THESE significant changes have been forecast and explained in the form of circular letters to each subscriber. The proposals were not made and steps to put them into effect were not taken until after an exhaustive survey had disclosed opportunities, which could not be neglected, in the direction of an expanded yet more economical service to the subscriber.

A STUDY of the pages following will give an idea of what we are striving to accomplish, without hinting finality in planning or selection or execution. The issue, however, answers for itself every question that has been asked to date by those readers who have been in doubt as to some of the details of the change. It will remove apprehension that the new program might mean the neglect of any important feature of interest and value.

THE disclosure of the plans to enlarge the usefulness of *Engineering and Mining Journal* has brought a response indicating a confidence that was more than gratifying, a confidence that will prove one of the major incentives in an effort to maintain, or even to enhance, the reputation of a long-established publication.

Historical Summary

Engineering and Mining Journal was founded in 1866 as the *American Journal of Mining,* with George Francis Dawson as Editor. In 1869 the name was changed to *Engineering and Mining Journal.*

Publications which have been absorbed are: 1875, *Coal and Iron Record;* 1877, *The Mining Review* (Denver); 1879, *The Polytechnic Review;* 1902, *Mining and Metallurgy;* 1906, *Mining Magazine;* 1917, *Mining and Engineering World,* The successive editors have been Rossiter W. Raymond, Richard P. Rothwell, Fred Hobart, David T. Day, T. A. Rickard, W. R. Ingalls, J. E. Spurr, and A. W. Allen.

On April 1, 1922, *Engineering and Mining Journal* was consolidated with *Mining and Scientific Press* as *Engineering and Mining Journal-Press.*

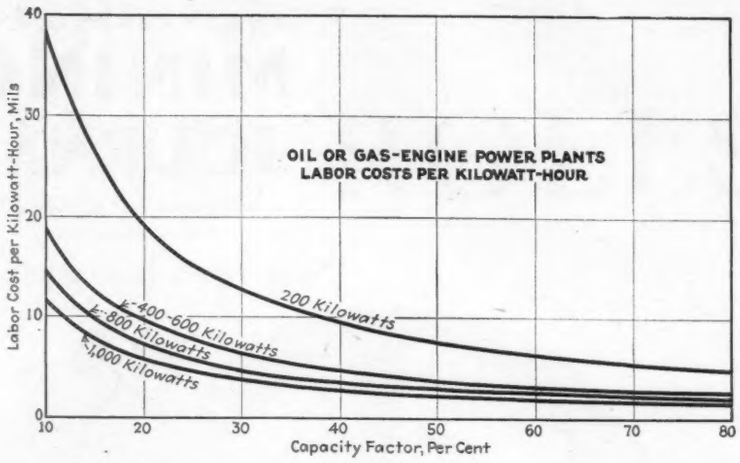
Mining and Scientific Press was established in 1860 as the *Scientific Press.* Three years later, *"Mining"* was added to the title. The editors have been Almond D. Hodges, Charles G. Yale, J. F. Halloran, T. A. Rickard (twice), and H. Foster Bain.

On July 1, 1926, the consolidated magazine reverted to its former name, *Engineering and Mining Journal.*

The staff of *Engineering and Mining Journal* consists of A. W. Allen, editor; E. H. Robie, George J. Young, and A. H. Hubbell, associate editors; W. N. P. Reed, H. D. Keiser and S. D. Strauss, assistant editors, and H. H. Wanders, market editor.

Issued twice each month

SHOULD POWER *be purchased when opportunity offers, or be generated on the property? What are the relative costs of operation with steam, oil, or gas, respectively? These and other questions of concern to the mining industry are answered by a consulting engineer of San Antonio, Texas.*



Power for the Mine and Mill

Phillips B. Tartt

ONE of the important problems which confronts the operator of mine or mill is the selection of a proper source of electrical energy for operating his machinery. The problem concerns not only the new project but the plant of long operation. Frequently, changes in conditions will make a change in power source a matter of importance in the cost of operations. The continued increase in the extent of power distribution nets or "grids" from large central stations in many districts makes it possible at times to effect economies in operations by purchasing energy rather than producing it with a private plant. However, this article should not be construed as a plea for the power companies. In many instances a properly operated private plant will produce energy more cheaply than it can be purchased. The purpose of this article is to point out certain salient facts which will enable the person intrusted with the operation of a property to make an intelligent investigation of this particular problem and assist him in weighing the relative advantages of various power sources. In any case, unless he, or some one in his employ, has had extensive experience in the power-producing field, economic comparison should be made by a competent consulting engineer specializing in this type of work before a final decision is reached. Money spent on a report of this nature will invariably be well invested.

The problem, as usually presented, consists of two main phases: (1) Should power be purchased or produced with a private plant? (2) If power is produced with a private plant, what type of plant will be most economical and satisfactory in the long run? These two phases are closely interconnected, and one must nearly always arrive at a solution of the second phase before an intelligent solution of the first can be worked out. Therefore, the problem will be attacked in the reverse order.

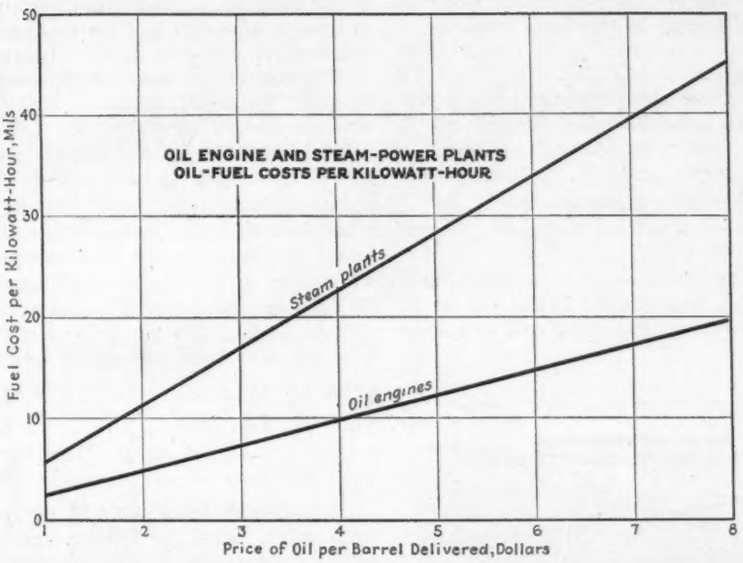
Many types of plant are available for producing power, but the five principal ones suitable for mineral properties may be classified as hydro-electric or water-power installations, steam engines, steam turbines, oil engines, and gas engines. When power is produced, its cost may be divided among the following: Fuel (if required), lubrication and supplies, repairs and maintenance, labor and administration, amortization of sum invested in plant, interest on investment, and, finally, taxes and insurance.

Irrespective of the type of plant, the capacity factor, or ratio of the amount of energy used to the amount of energy the plant would be capable of producing if operated continuously at full capacity, is the most important element entering into the cost of energy produced. This is obvious when consideration is paid to the fact that every one of the cost items of the preceding paragraph, except the first three, will vary exactly inversely with the capacity factor. The first three items, as well, will be greater for low than for high capacity factors, although the variation is not nearly so great as in the remaining items.

The peak load or maximum power demand will obviously determine the required capacity of the plant to be installed; and, consequently, the cost of the plant. In estimating the peak load, every effort should be made to anticipate the extreme future requirements for the life of the plant, with provision for future extensions to care for this condition. In general, however, to install enough capacity to care for the immediate future only is more economical, adding capacity as required. Great care must be used in estimating the "peak load." In many cases, the numerical sum of the horsepower ratings of all motors will be a fair estimate of the peak load in kilowatts, for which design should be made. This rule should not be followed blindly, however, and it could lead to serious errors, in design, particularly, if one or more large squirrel-cage motors were on the load. The determination of peak load for design as well as load factor should preferably be placed in the hands of an experienced engineer.

Before proceeding to the selection of a plant type, the capacity factor and the peak load must be ascertained. Assuming that these data are available, one may proceed with the consideration of the various types of plant and their respective economic merits for the operation in hand.

The hydro-electric plant is, of course, available only in certain localities, and, despite an extremely prevalent idea, it is not always the cheapest source of power. True that, with this type of plant, no fuel expense is involved, but this saving is frequently offset by the relatively heavy fixed charges of amortization, interest, taxes, and insurance, as well as labor, repairs, and maintenance under certain conditions. However, if a sufficient amount of hydro-electric power can be developed within a reasonable transmission distance of the property, the possibilities should be very carefully investigated, and the cost of installation and operation estimated as



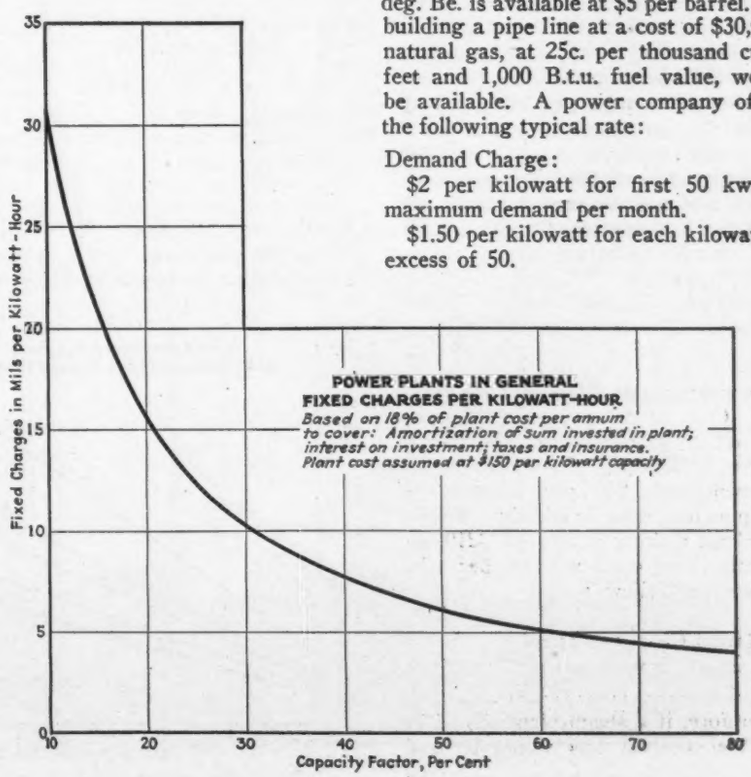
closely as possible, for comparison with other types of power source. This work again is best intrusted to an able and experienced engineer. However, should the expense of such an investigation be considered unjustifiable, the manufacturers of machinery for such plants are generally willing to make preliminary investigations and estimates if the project appears to have real merit. Needless to say, such an investigation should be carefully checked before a decision is made.

If energy is to be produced by burning fuel, steam plants have the advantages of reliability and adaptability to almost any kind of fuel that may be available. These advantages are partly offset by the fact that, particularly in the smaller units, steam plants do not use oil or gas fuel as economically as oil or gas engines. Many cheap oils, however, which would be entirely unadaptable to use in oil engines, give excellent results as boiler fuels for steam plants. In a given locality, the steam plant, with its less economical use of a cheap, high-sulphur or dirty oil, may be more economical to operate than a more efficient oil engine, which requires a more expensive grade of fuel oil. Therefore, the delivered costs and properties of all available fuels, such as natural gas, fuel oils, wood, lignite, and coal, should be studied, together with their respective fuel values. The prospective supply of the various fuels to meet future demands should also be carefully considered, and future cost variations prognosticated so far as possible.

All steam-, oil-, and gas-engine driven plants need water in considerable amounts, although the requirement may be reduced to a minimum in condensing-steam plants, and in oil- and gas-engine plants, by cooling and re-using the circulating water. The amount and quality of water available should be carefully investigated, and the cost of treatment, if required, determined.

The ideal fuel for the gas engine is natural gas. Many internal-combustion engine installations use producer gas, and, if a plentiful supply of wood, charcoal, or similar fuel is available, the economic merits of a producer-engine installation should be investigated. Careful experimental work should be done to assure the cost and quality of gas to be expected from the fuel in question.

Oil engines do not usually operate satisfactorily on an oil heavier than 22 deg. Bé., and I feel that no oil containing more than 0.25 per cent sulphur should be considered a satisfactory Diesel fuel. This should be borne in mind in comparing fuel costs for Diesel and steam plants.



For convenience in making preliminary studies, I have prepared the accompanying charts, which, when intelligently used, will give, in most cases, a fair approximation of the results to be expected from the operation of various types of mine or mill power plants. These charts and the accompanying assumptions are, for the sake of simplicity and generality of application, necessarily inexact, but the errors involved are not great enough to prevent their being a valuable aid for preliminary work.

For use in connection with the charts, the following cost assumptions may be taken as fairly close for general operating conditions:

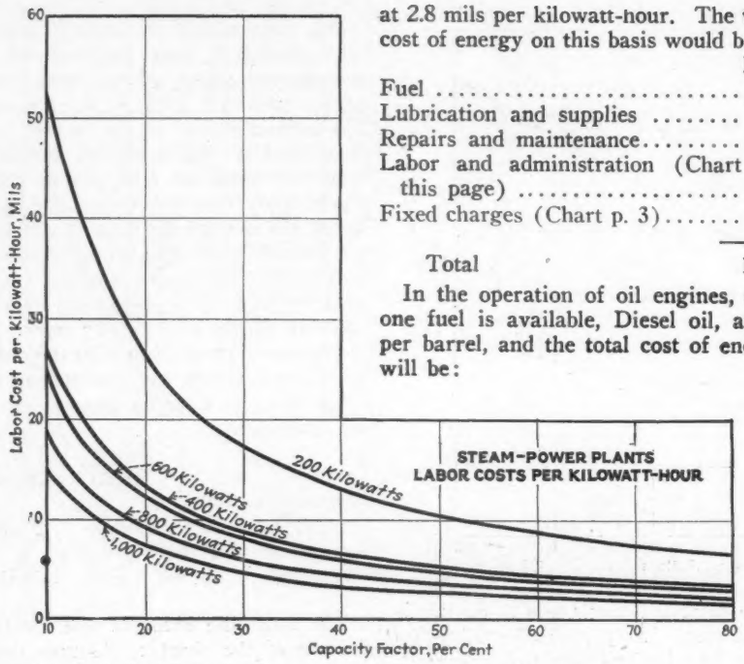
	Steam Plants	Oil or Gas Engines
Lubrication and supplies	1 mil	2 mils
Repairs and maintenance	1 mil	2 mils

The following example will illustrate the use of the charts: Assume that a plant capacity of 500 kw. is required, and the average annual capacity factor will be 40 per cent. An investigation shows that an adequate hydro-electric plant could be built for $250 per kilowatt of capacity, and that the labor, supplies, repairs, and maintenance would be about the same as for a steam plant of the same size. A transmission line costing about $15,000 would have to be built from the hydro-electric plant. A coal of 12,000 B.t.u. calorific value is available at $2 per ton. Mexican crude oil of 15 deg. Bé. and about 3 per cent sulphur is available at $3 per barrel, and a good low-sulphur Diesel oil of 24 deg. Bé. is available at $5 per barrel. By building a pipe line at a cost of $30,000, natural gas, at 25c. per thousand cubic feet and 1,000 B.t.u. fuel value, would be available. A power company offers the following typical rate:

Demand Charge:

$2 per kilowatt for first 50 kw. of maximum demand per month.

$1.50 per kilowatt for each kilowatt in excess of 50.



at 2.8 mils per kilowatt-hour. The total cost of energy on this basis would be:

	Mils
Fuel	2.8
Lubrication and supplies	1.0
Repairs and maintenance	1.0
Labor and administration (Chart this page)	6.3
Fixed charges (Chart p. 3)	7.7
Total	18.8

In the operation of oil engines, only one fuel is available, Diesel oil, at $5 per barrel, and the total cost of energy will be:

	Mils
Fuel (from Chart p. 3)	12.3
Lubrication and supplies	2.0
Repairs and maintenance	2.0
Labor and administration (Chart p. 2)	4.8
Fixed charges (Chart p. 3)	7.7
Total	28.8

In the use of gas engines, only one fuel is available, natural gas, at 25c. per M. cu.ft. The total cost of energy will be:

	Mils
Fuel	4.4
Lubrication and supplies	2.0
Repairs and maintenance	2.0
Labor and administration (Chart p. 2)	4.8
Fixed charges (Chart p. 3) $7.65 \times \frac{210}{180}$	10.7
Total	23.9

From the preceding figures, a steam plant producing energy at 18.8 mils will be the cheapest, provided that the supply of coal is adequate and little danger is expected of a rise in price. Judgment of local conditions must decide whether it would be better policy to build the steam or hydro-electric plant.

The first phase of the original problem is now ready to be attacked. The power company's rate must first be investigated. As the "demand" is usually based on the average maximum demand over a 15-minute period, assume 80 per cent of the plant capacity and call the demand 400 kw. instead of 500. The demand charge per month will be:

$2.00 × 50	$100
$1.50 × 350	$525
Total 400	$625

On a 30-day basis with 50 per cent load factor, based on 400-kw. demand, which corresponds to the assumed 40 per cent capacity factor based on 500 kw., a total of 500 × 0.4 × 24 × 30 = 144,000 kw.-hr. will be used per month. The energy charged will then be:

0.04 × 100 =		$ 4
0.03 × 1,000 =		30
0.02 × 10,000 =		200
0.015 × 132,900 =		1,990
Total	144,000	$2,224
Plus demand charge		625
Total per month		$2,849

Average cost per kilowatt-hour
2,849,000/144,000 = 19.8 mils.

From the preceding results, steam power produced with a private plant will cost about one mil per kilowatt-hour less than the rate offered by the power company in this case.

Energy Charge:

4c. per kilowatt-hour for first 100 kw.-hr. per month.

3c. per kilowatt-hour for next 1,000 kw.-hr. per month.

2c. per kilowatt-hour for next 10,000 kw.-hr. per month.

1.5c. per kilowatt-hour for all in excess of 11,100 kw.-hr. per month.

The estimated life of the mine will be ten years or better. What type of plant will be most economical, and will it be more economical to purchase or produce power?

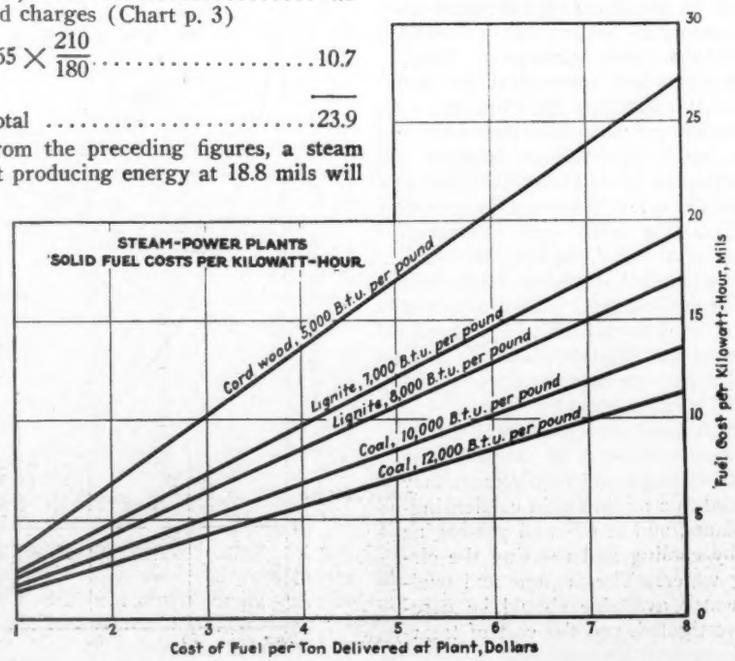
In the hydro-electric plant, the transmission line will add $30 per kilowatt to the estimated plant cost, making a total of $280 per kilowatt. No fuel cost. The cost of energy per kilowatt-hour will be:

	Mils
Lubrication and supplies	1.0
Repairs and maintenance	1.0
Labor and administration	6.3
Fixed charges (Chart p. 3) $7.65 \times \frac{280}{150}$	14.3
	22.6

In a steam plant, three fuels are available: Coal at $2 per ton; Mexican crude oil at $3 per barrel, and gas at 25c. per 1,000 cu.ft. In regard to the last mentioned, $60 per kilowatt, to cover pipe line, must be added to the cost of a plant, making a total of $210 per kilowatt. Fuel costs will be, per kilowatt-hour, as follows:

	Mils
Coal (from Chart this page)	2.8
Mexican oil (from Chart p. 3)	16.9
Gas	8.5

Therefore, if a steam plant should be used, the cheapest fuel would be coal


STEAM-POWER PLANTS
SOLID FUEL COSTS PER KILOWATT-HOUR
Cord wood, 5,000 B.t.u. per pound
Lignite, 7,000 B.t.u. per pound
Lignite, 8,000 B.t.u. per pound
Coal, 10,000 B.t.u. per pound
Coal, 12,000 B.t.u. per pound
Fuel Cost per Kilowatt-Hour, Mils
Cost of Fuel per Ton Delivered at Plant, Dollars

A Trip Through the New Nichols Copper Refinery at El Paso, Texas

Edward H. Robie
Associate Editor

THE latest plant to be built is not always the best, but I think no one can go through the new copper refinery of the Nichols Copper Company, eight miles east of El Paso, Tex., without feeling that here is an example of the most up-to-date design coupled with a liberal and intelligent expenditure of money. Built for permanence and economical upkeep, and low operating costs, the operators here have a plant to be proud of and one that will be a continual source of inspiration in their work.

A copper refinery for the Southwest has been discussed for several years, first one company and then another being mentioned as being behind the project. The rapid industrial growth of the Southwest and the Pacific Coast region has made the establishment of a copper refinery in that territory of increasing importance from the domestic point of view, and the opportunity of shipping for export from Gulf and California ports affords a saving compared with that of refining in the New York district, where most of the American copper refineries have heretofore been located. In addition to the transportation factor may be mentioned the increasing tendency toward more compact mining, smelting, and refining units where large tonnages are involved; and the fact that at El Paso, particularly, an excellent site was available at reasonable cost, labor was plentiful, and a choice of two highly desirable fuels—natural gas and fuel oil—was offered.

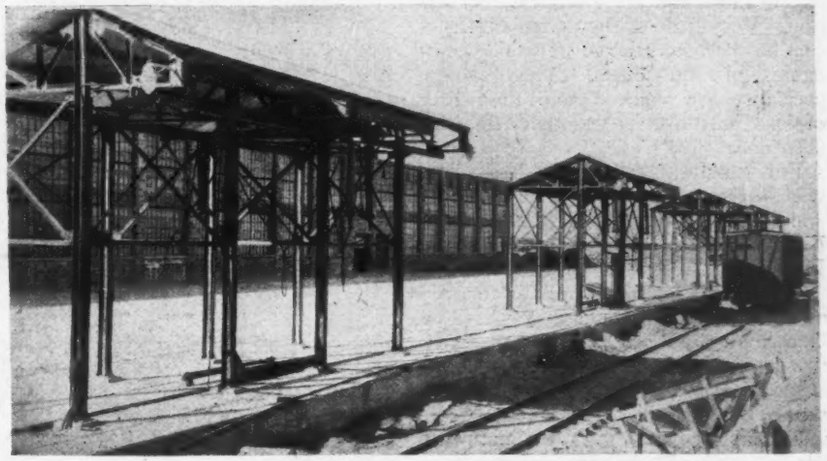
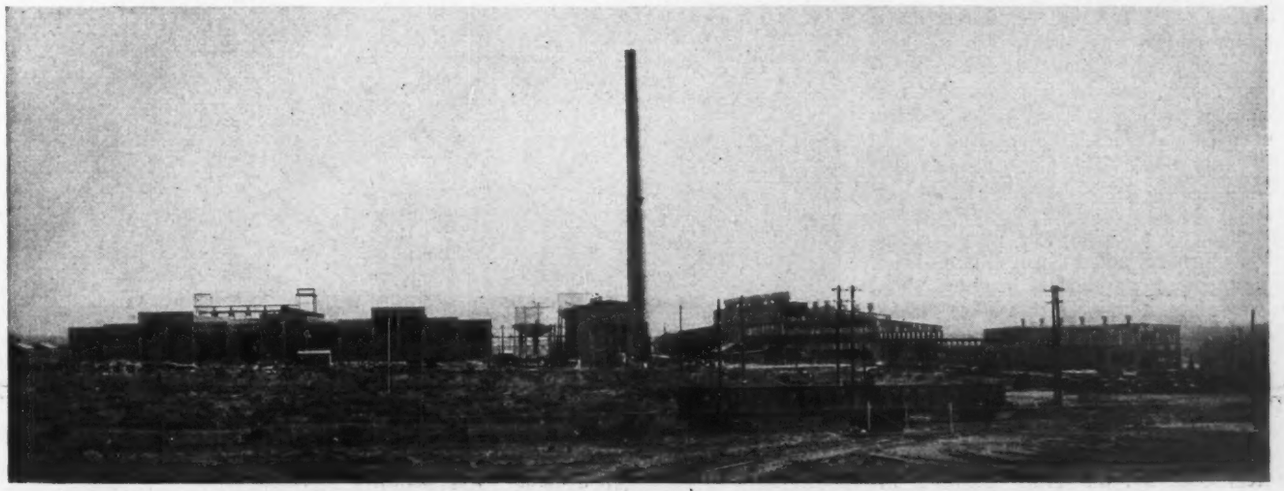


Fig. 1—Unloading platform, showing pneumatic hoists, with electrolytic building in background

The association of the Nichols Copper Company with the Phelps Dodge Corporation, a rather intimate connection of long standing, and more recently with the neighboring Arizona company, Calumet & Arizona Mining Company, together with the long experience of the Nichols company in copper refining at Laurel Hill, New York City, made Nichols the logical organization to undertake the refining, *in situ*, of Southwestern copper. To finance the project, which is a four million dollar job, the Nichols Copper Company sold stock to Phelps Dodge and Calumet & Arizona to the amount of about 40 per cent of its present outstanding capitalization. Those who will supply the raw material for the refinery, therefore, will have a direct interest in the new plant, although the actual operation is vested entirely in the Nichols company. It has been



agreed that the copper to be produced here will be of as good a grade as the "LNS" brand refined at Laurel Hill, which has long been highly regarded in the trade. Just how long is indicated by the fact, perhaps not generally known, that the initials "LNS," or rather "NLS," stand for "Nichols Lake Substitute," the brand having been introduced when Lake copper was dominant, which was many years before I had any interest in the copper market.

This new refinery was projected early in 1928, and Archer E. Wheeler, a consulting metallurgical engineer in New York, was selected to design it, in cooperation with company officials and some of the present operating staff. Stone & Webster undertook the work on the substation and electrical distribution. Very little of the actual construction has been contracted to outside companies or individuals, though where specialists are required, as in the matter of lead burning, for example, this has been done.

For the site, 580 acres of desert land was selected, on the Southern Pacific and Texas & Pacific eight miles east of El Paso, and adjoining on the west the Pasotex oil refinery. Ample room is thus afforded for expansion, or for sale of land to others should that course be later found desirable. It seems likely that an eventual increase in the refinery capacity may be required, or possibly a wire or rod mill may be built as the industrial demand in the Southwest broadens. A rod mill has recently been built at Birmingham, Ala., to supply the southeastern section of the country. A year ago, or in December, 1928, the refinery site was entirely undeveloped, so construction will be completed and production begun in but little more than a year after the first spadeful of earth was turned. In fact, the first starting sheets were made in less than a year's time. At the time of my visit, in the middle of December, the project was about 90 per cent complete, and it was expected that commercial copper would be produced in February, 1930.

The capacity of the plant is expected to be 100,000 tons a year, the cost of the plant being about $40 per ton of rated annual capacity, not an unreasonable figure considering the quality of construction, which is of the highest grade throughout, and the fact that this cost includes an $800,000 substation, administration and office buildings, and several dwelling houses for plant officials and foremen. In general, the plant consists of an unloading shed, electrolytic department, copper sulphate plant, substation, furnace and casting plant, brick storage and warehouse, machine shop, assay office, administration office including a laboratory, water and acid storage tanks, and a balloon flue and stack.

Copper from the two Douglas smelters, and from that at Clifton, Ariz., in amount approximating two-thirds of the current production at these plants, is received at the unloading platform in box cars, in the form of anodes exclusively. This is made possible by the development of satisfactory anode casting equipment and practice at these plants, that at the Phelps Dodge smelters being a continuous process devised by

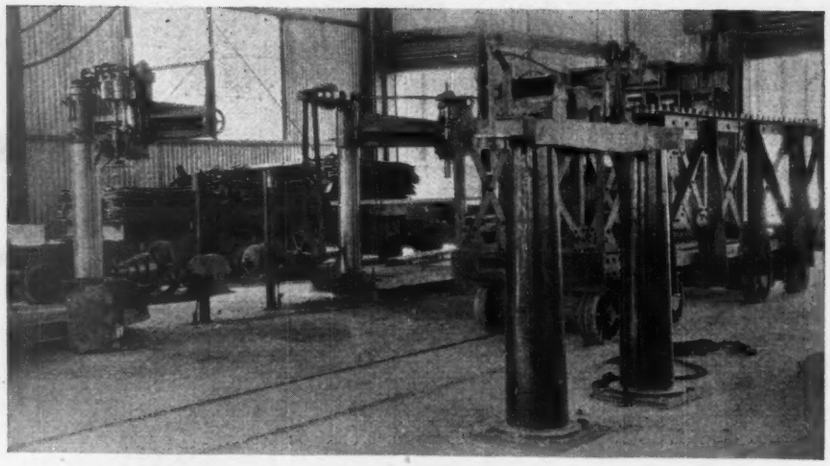


Fig. 2—Sample room, showing scales, drill presses, and anode rack

Fig. 3—General view in electrolytic department, showing concrete tanks and supports

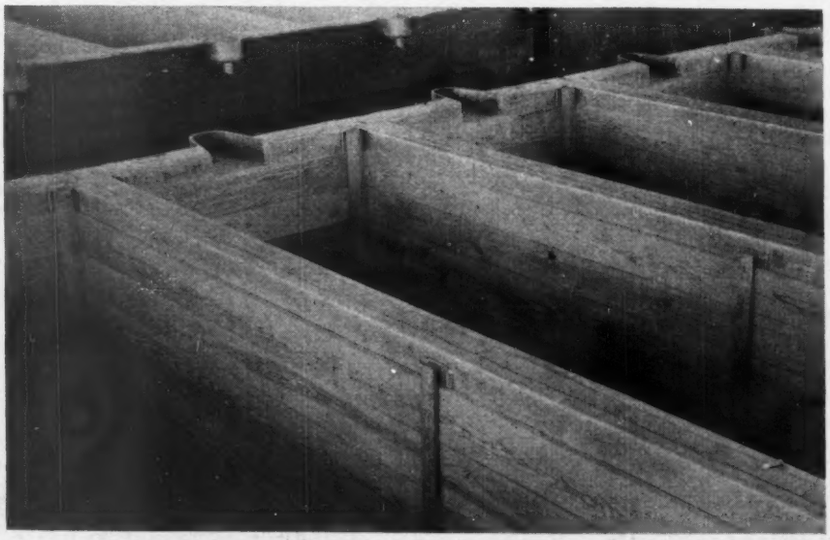


Fig. 4—Wooden lining of tanks, and method of securing it in position

Colonel Stout, whereas that at Calumet & Arizona will follow more the practice at the El Paso smelter of the A.S.&R., where a batch process is used.

In the following brief description of the equipment, which I hope to supplement later on by a more informing discussion of the actual operation of the plant, I shall omit machinery details and manufacturers' names, but those who are interested may obtain this information by the references given in superior figures, which will be grouped together at the end of the article.

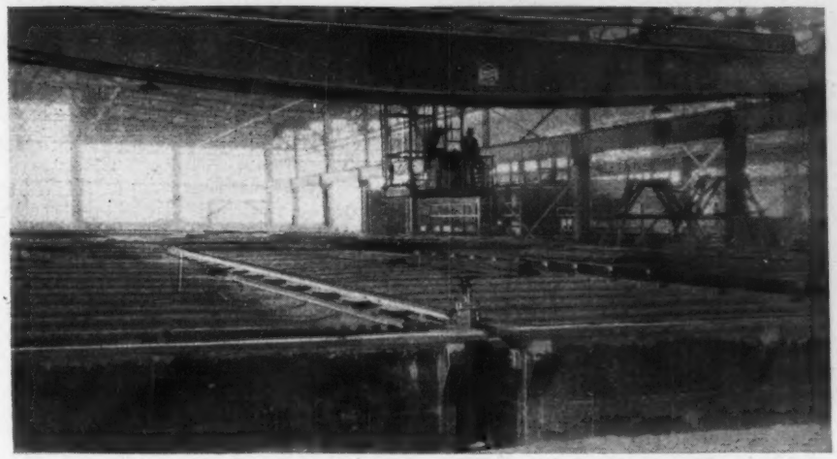


Fig. 5—Crane and concrete tanks, with busbars and piping in place

A special anode lift truck[1] will remove the anodes from the cars to the unloading platform. From the truck they will be lifted by one of several air hoists[2] using 100-lb. air and placed in anode trucks properly spaced for lowering into the electrolytic tanks. Several groups of these hoists are provided (see Fig. 1), with ample trackage facilities. It is estimated that a carload of anodes can be unloaded in thirty minutes. The loaded anode racks then pass over track scales[3] for a double weighing, this equipment being under cover in the sample house (Fig. 2). Every third or fourth rack will be switched past a drill press[4] where a ¾-in. hole will be drilled in each anode and the sample sent to the laboratory. The anodes will then be reloaded on another rack car and forwarded to the electrolytic department.

As the plant is laid out on a gentle slope, the unloading platform is on a level with the working floor of the electrolytic department; and the cellar of that department, to which the cathodes are lowered and from which they emerge, is at the same level as the charge floor of the wirebar furnaces. The furnace casting floor is some ten or twelve feet below the charge floor, and the railroad spur on which the cars are spotted for shipping finished forms is at a convenient level below the casting floor.

The reinforced concrete tanks in the electrolytic department are one of the most interesting features of the plant from a constructional standpoint. They are each 13 ft. 2 in. long inside, 42½ in. wide, and 45 in. deep, and sixteen are cast *en bloc,* side by side, lengthwise. Heat is thus conserved to some extent. Some criticism has been offered for this method of construction by others who favor the sectional type of construction, but no troubles have yet been experienced. Fig. 3 gives an excellent idea of the tank construction, with the position of the four supporting pillars. Fortunately a firm hard-pan foundation is available, so no uneven settling is expected. At the new refinery under construction at Copper Cliff, Ont., sectional concrete tanks are being installed. Particular care was taken at El Paso in a proper composition of the concrete, and in the pouring. A mixture of 2 parts of quartz aggregate, 1½ parts of silica sand, and 1 part of cement was used in the mix, the sand used being of especially high silica content. Frequent lead-lined weep holes, at about 1x2-ft. intervals, have been provided in the tank bottoms, so that any leakage can be localized. The outside of the tanks is painted black with an asphalt paint.

After the cement has dried it is sprayed with asphalt and lined with 8-lb. sheet lead, of 6 per cent antimonial content. Mastic lining was considered, but none was available that could be depended on for temperatures up to 150 deg. F., and as the working temperature was to be 135 deg., this factor of safety was demanded. However, there seems to be some prospect that a mastic of the proper qualifications may be secured.

On some of the tanks, but not all, the lead lining is being protected by wooden boards, as is shown very clearly in Fig. 4. These cover the bottom as well as the sides, and are designed to protect the lining from inexpert manipulation in the processes of charging and pulling. Later on, the boards will probably be dispensed with. They must, of course, be removable to facilitate cleaning, so a scheme of fastening them in by welding a lead T-strip on to each side of a tank has been devised. (See Fig. 4). One end of the boards slides into this T-groove, and the other end is keyed into a wooden post in each of the four corners of the tank.

Three openings are provided in each tank: One in the end about 4 in. from the bottom, through which the electrolyte flows into the tank; an outlet at the top at the opposite end (Fig. 4), and an opening in the bottom fitted with a tapered lead plug, with rubber ring, for slime drainage into lead-lined launders below.

The 1,152 tanks are grouped in 36 sections of 32 tanks each. Of these, 64 will be used for producing starting sheets, and several cells were working on starting sheets at the time of my visit. Each of these stripper cells contained 29 anodes and 28 mother blanks on which the starting sheets were deposited. The commercial cells will contain 33 anodes and 34 cathodes. The 700-lb. anodes are spaced at 4½-in. centers. Half a tank is pulled at a time.

In Fig. 6 is shown one of the starting blanks, on which, it may be noted, the so-called Kitchener groove is used to facilitate stripping. However, the groove is not desired on the face of the blank at the bottom, but rather on the bottom *edge,* so the blanks are being trimmed and cut with this in view. Having the bottom groove on the edge instead of

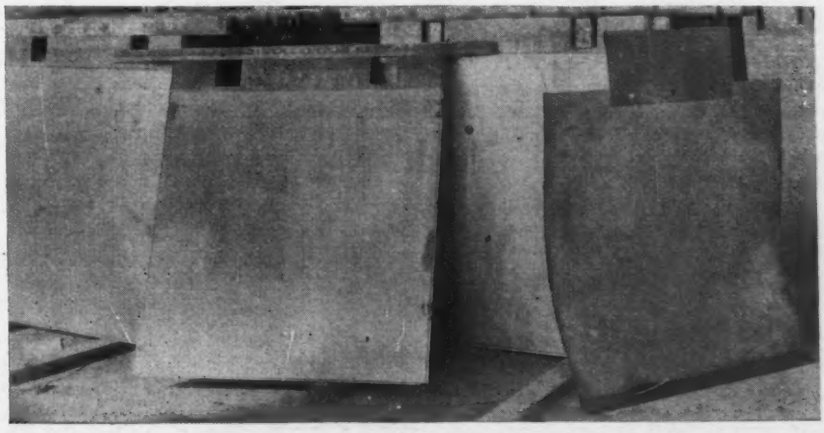


Fig. 6—On the left a starting blank, and on the right a starting sheet

the face decreases the amount of scrap made. A special Texas light gas oil[11], with paraffin base, is swabbed on the blanks before immersion in the electrolyte, this particular oil giving better stripping than many others that have been tried. In Fig. 6, on the right, is shown a starting sheet with loop attached. A quarter of the starting sheets are used for loops, going first to a gang slitter[12], then to a shear, and finally to the loop machine, where three triangular holes are punched and clipped at once.

Electrolyte is distributed from the head tank through lead pipes with gate valves and rubber and glass outlets, to each individual cell. The overflow passes in part to lead pipes and in part to stoneware pipes. The stoneware is cheaper and a good insulator but on account of the ease of breakage is not so popular as the lead.

Return electrolyte is pumped[8] to the storage tanks in the center bay of the building. (See Fig. 7). The proper temperature is maintained by diverting a portion of the electrolyte to heaters, some of which are shown in Fig. 8. These are steel cylinders, lead lined throughout, with longitudinal tubes through which the electrolyte circulates, while waste-heat steam from the wirebar furnaces is maintained under pressure in the interior of the cylinder surrounding the tubes. This heater was devised by Mr. C. W. Nichols about two years ago for heating electrolyte at the Laurel Hill plant of the company, and has been especially successful. A detailed drawing of the device will appear in the next issue. The temperature of the electrolyte in the cells will be maintained at 135 deg. F. Circulation will be from 3 to 5 g.p.m. per cell.

Nothing but distilled water—condensed waste-heat steam—will be used for make-up, and glue will be the only addition agent. Hydrochloric acid instead of salt is favored, in order to avoid the introduction of sodium salts in the electrolyte. Though the impurities in the blister copper, particularly that from Clifton, are small, of course they tend to accumulate, so that a certain portion of the electrolyte must be discarded from the plant. Ordinarily, refineries extract the copper from this waste electrolyte by passing it through cells with insoluble anodes, making a comparatively impure cathode copper that may have to be returned to the anode furnaces and that is always an undesirable addition to the wirebar furnaces. The problem of disposal of the waste electrolyte still remains. Here, as at Laurel Hill, the copper is recovered as blue vitriol in a separate plant with a bluestone capacity of 250 tons a month, and the only waste product from the electrolytic department is a solid residue that may easily be disposed of; the matter of stream pollution is entirely obviated. The waste electrolyte is first neutralized with copper shot, and the resultant solution evaporated to the proper density. The copper sulphate is then crystallized out on copper rods. In the building in which this work is to be carried on, only the steel framework was completed in the middle of December, as this will be the last department of the plant to be required. Owing to the amount of lead-lined equipment necessary, particularly sturdy construction is required.

Slime from the cells flows by gravity to a slime-collecting pit, through open lead-lined launders. These pits, like the electrolyte storage tanks, are in the middle bay of the building, and are built at the lowest point of the cellar. They are of reinforced concrete, lined with lead. In the center, underneath the lining, is a sump equipped with a pump in

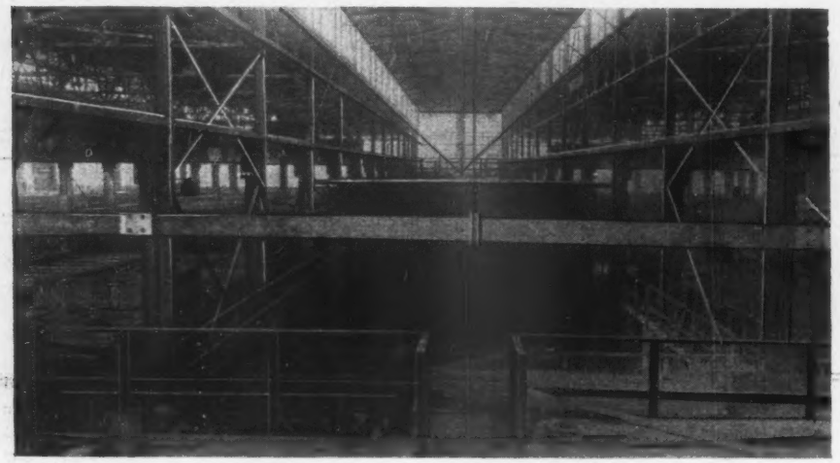
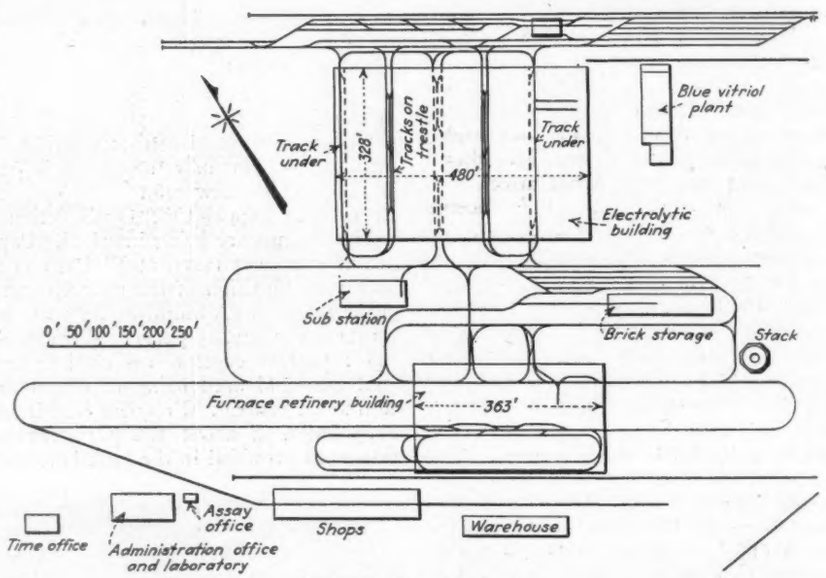


Fig. 7—Central bay in electrolytic department, showing electrolyte storage tanks and electrical conductor



General plan of plant

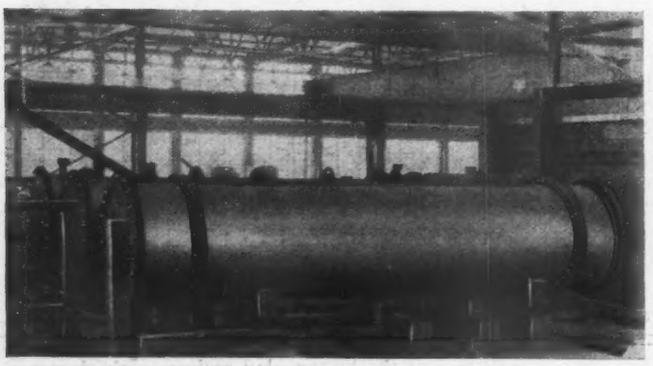


Fig. 8—Three of the electrolyte heaters, just being installed

case leaks should develop. From the slime-collecting pit, the slime is pumped to a separate building, where it is filter-pressed and washed. The solid material is then roasted at a low temperature in a Herreshoff furnace to oxidize the copper present, and is then leached with sulphuric acid. The residue, containing the precious metals, is then washed, filtered, and dried, and shipped east. Doré will later be made at this plant and shipped for parting, according to present expectations. There is nothing unusual in this part of the plant, with the exception of the use of a Herreshoff furnace instead of a small reverberatory for oxidizing.

Fig. 9 — Pulling starting sheets in the early work

The electrical system makes a particularly good impression on the visitor. Power is purchased from an independent power plant, using natural gas, that is just being completed about fifteen miles away, west of El Paso. It is received at 2,300 volts at the substation, which is equipped with motor-generator sets[6] and air-compressor equipment[7] for the hoists and furnaces. The usual accessory air-cleaning[8] and armature cooling equipment[9] is also installed here. Aërial conductors lead from the substation and enter the electrolytic building near the roof, the conductors passing down the walls or through the top of the building to the cell circuits. One of these conductors may be seen crossing the tank in Fig. 7, which also shows the method of support, with porcelain insulators. A busbar area of 1 sq.in. per 400-amp. carrying capacity is allowed. The Whitehead system of single contact is used, in which the cathode bars of one cell rest directly on the anode lugs of the adjoining cell, assuring approximately a 7 per cent saving in electrical power compared with that consumed when the double contact system is used. Use of single contact on the stripper cells is, I believe, unique. The plant is designed to operate at a current density of approximately 15 amp. per square foot. Return conductors from the cells pass down into the cellar, and back to the substation.

Insulation is everywhere given particular care. The busbars are insulated from the concrete tanks by strips of fiber[10] both on the bottom and side. Wooden blocks separate the various sections, with glass insulators against the tanks. The lead lining is separate for each cell and the joint between adjoining cells is filled with asphalt. All launders and pipes are insulated from the tanks. The concrete piers supporting the tanks are capped with heavy slabs of glass. As a result of these precautions, and the use of concrete tanks perhaps, absolutely no trace of copper precipitation has yet been found in any of the pipes during the several weeks that manufacture of starting sheets has been going on.

The four production bays of the building are served by five 12½-ton cranes[11],

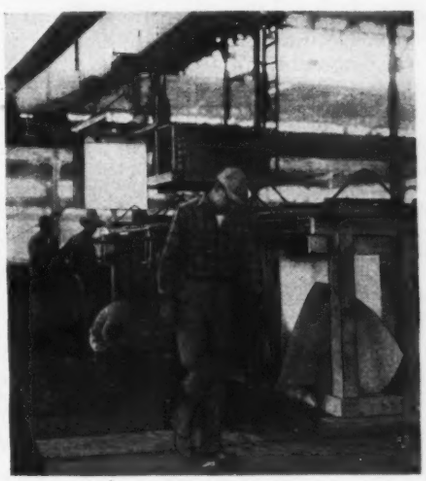


Fig. 10—Stripping some of the first starting sheets in the new refinery

and at one end of the building a transfer crane[11] is provided so that, in case of breakdown, equipment from another bay may be substituted. All five cranes could be put in one bay if desired. The crane runs are shorter than in any other refinery in the country. The roof of the building is 3 in. thick, of cast gypsum, adopted chiefly because it is a poor conductor of heat. Over this is a five-ply layer of paper, covered with a tar and gravel surface[12]. All steelwork will be sprayed with gray asphalt paint, and the interior surface of the gypsum roof will be painted in the course of a year after it has dried out and set. Natural ventilation is expected to be sufficient for this building, but forced ventilation can be installed later on if found desirable. Evaporation is rather active in the arid El Paso climate.

The cellar is arranged for convenient access to all piping, and for the easy location and repair of all leaks. A 7-ft. headroom is provided. The floor is of concrete, covered with ¾ in. of asphalt mastic, with rock dust sprinkled over the surface.

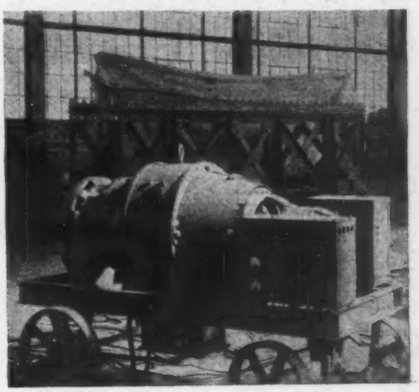
It is interesting to observe that in this plant the multiple system has been used, though the Laurel Hill plant of Nichols is a series plant. Difference of opinion still exists as to whether or not a series system should have been installed at El Paso. Many improvements have been made in it in recent years, and it is claimed on good authority to be cheaper than the multiple system. The copper to be refined at El Paso is so pure that it would be ideal for series treatment. However, a saving could be shown in casting anodes from converter copper at the smelter, and it was more feasible to cast and ship them as multiple rather than as series anodes.

Cathodes, after washing, are lowered by a mechanical loading machine onto cars on tracks in the cellar, hauled to scales in the yard, and then enter the furnace building on the working floor. All handling of cathodes is mechanical so far as possible. Some surprise may be evidenced at the distance—about 250 ft.—between the electrolytic and furnace buildings, but the designers have taken particular pains to provide ample space everywhere for expansion and storage, and any short additional haul thereby required is of insignificant importance.

The furnace building contains two wirebar furnaces and one anode furnace, which latter will be used only for anode scrap so long as all copper comes in the form of anodes. The latest type of charging machines has been installed here. Natural gas will be used to fire the casting furnaces, which will be equipped not only with waste-heat boilers for supplying steam to heat the electrolyte, but will also have carborundum air preheaters[10] by which the air necessary for combustion will be raised probably to about 800 deg. F., with the expectation that a fuel saving of from 10 to 20 per cent can be made. An improved form of Clark casting wheel, 40 ft. in diameter, is being installed. Details of the equipment in this department of the plant will be published in the next issue.

An adequate water supply is assured

Fig. 11—In the machine shop; a portable electric welding outfit



from a 700-ft. well that has been sunk on the property, which provides a flow of comparatively pure water, though containing a little salt. The pumping equipment[13] whose capacity is 1,000 g.p.m., is housed in the substation. Two storage tanks are provided, one of 200,000- and the other of 600,000-gal. capacity, assuring a supply for eighteen hours' operation. A pump installation[14] near the substation raises the tank pressure from 30 to 80 lb. for plant use. No water is used twice for the same purpose, even in the boshes for cooling copper, the outflow from which goes to settling ponds and then is used for irrigation about the plant and to keep down dust.

Transportation about the plant has been well taken care of by an unusually convenient layout of tracks. Most of this is 40-lb. steel, 30-in. gage, with manganese-steel switch points. The maximum grade is 1 per cent and the minimum curve of 25-ft. radius. Storage-battery locomotives[15] are used for haulage.

Every evidence is afforded that the best of equipment has been used throughout. The buildings are of hollow-tile construction, or of galvanized copper-bearing steel[16]. As is fitting, copper is used wherever its advantages are manifest, as for louvres and flashing about the buildings. Direct drives are used throughout, with modern types of speed reducers where necessary. A well-equipped machine shop containing a planer, rip saw, band saw, steam hammer, punch and shear, drill press, lathes, and pipe threaders is provided, with an electric repair shop and equipment for electric and gas welding. (See Fig. 11.) The administrative buildings and laboratories are in the southwestern modified Spanish style of architecture, with ample air space in the roof to insulate against the hot summer sun. On all of the plant buildings aluminum paint will be used within the next year, combining a durable and efficient coating with a clean and well-kept appearance.

My thanks are due to Mr. W. C. Bennett, vice-president; to Mr. F. M. Shaw, works manager; to Mr. J. R. Stack, assistant works manager; and to Mr. J. H. Dyer, mechanical superintendent, for their kindly co-operation in making it possible for me to compile these brief notes, and to Mr. C. W. Nichols, Mr. A. E. Wheeler, and Mr. Stack for looking over the manuscript.

Types of Equipment Used in the New Nichols Refinery

1. Storage-battery truck—Baker & Co., Cleveland, Ohio.

2. Pneumatic hoists — Curtis Pneumatic Machinery Company, St. Louis, Mo.

3. In the plant are five Type T-10-45 two-section 30,000-lb. track scales, and also a standard-gage track scale—Fairbanks, Morse & Company, Chicago.

4. Two sample-mill drill presses—Canedy Otto Manufacturing Company, Chicago Heights, Ill.

5. Electrolyte pumping equipment—Eight Antisell type pumps, National Lead Company, New York, 9-in. discharge, each with a capacity of 1,280 g.p.m. There are also two emergency pumps, similar to the 9-in. pumps, to operate from a storage-battery.

6. Three motor-generator sets—General Electric Company, Schenectady, N. Y., 1,500 kw., consisting of 2 type MPC 10-pole 750-kw. 90/150-volt shunt-wound generators on common base, with 1 type TS 1,800-kva. synchronous motor, 2,300 volt, 514 r.p.m., and 1 type ECR 24-kw., 125-volt, compound-wound exciter.

7. Two high-pressure air compressors —Ingersoll-Rand Company, New York. 21x12½x14 in., Type PRE-2, with 225-hp. synchronous motor. Two low-pressure air compressors. Ingersoll-Rand, 15x12 in., Type XRE-1 duplex, connected with 125-hp. synchronous motor.

8. National Air Filter Company, Louisville, Ky.

9. Three Size 8, turbo-conoidal fans—Buffalo Forge Company, Buffalo, N. Y.

10. Delaware Hard Fibre Company, Wilmington, Del.

11. Crane equipment:

Electrolytic Department, five 12½-ton two-hook Milwaukee cranes—Milwaukee Electric Crane & Hoist Corporation, Milwaukee, Wis. One transfer crane. Series No. 14—Bedford Foundry & Machine Company, Bedford, Ind.

Substation: One 15-ton Bedford crane.

Furnace refinery: Two 15-ton Milwaukee cranes in casting bay. One 10-ton Milwaukee crane in shipping bay. One 5-ton Milwaukee crane in charging bay. Two 3½-ton charging cranes—Morgan Engineering Company, Alliance, Ohio. One ½-ton anode bosh crane. "Shaw" — Manning, Maxwell & Moore, Inc., New York.

Machine shop: One 10-ton Milwaukee crane.

12. Barrett Specification Roofing, Barrett Company, New York.

13. One deep-well pump—Layne & Bowler, Inc., Memphis, Tenn.

14. Four pumps, electrically driven, of 500-, 1,000-, and 1,500-g.p.m. capacities; and 1,500-g.p.m. capacity driven by a Continental gasoline engine—Goulds Pumps, Inc., Seneca Falls, N. Y.

15. Four electric locomotives, 10-ton, each equipped with a 132-cell Edison A-10 storage battery — Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

16. Tennessee galvanized copper-steel sheathing — Tennessee Coal & Iron Company, Birmingham, Ala.

17. Humble Oil & Refining Company, Baytown, Tex.

18. Slitter and shear for starting sheets. "Pexto"—Peck, Stow & Wilcox Company, Southington, Conn.

19. Fitch furnace air preheater—Carborundum Company, Niagara Falls, N. Y.

Water-softening plant, hot process, capacity 4,500 gal. per hour—Graver Corporation, East Chicago, Ill.

Waste-heat boilers, 2,600-hp.—Combustion Engineering Corporation, New York.

Stack, 410 ft. high, 13 ft. diameter at top, 28 ft. 6 in. inside diameter at bottom —Custodis Chimney Construction Company, New York.

Sheet lead. The plant contains a quarter of a million dollars' worth of lead—National Lead, New York, and A. S. & R., Selby, Calif., plant.

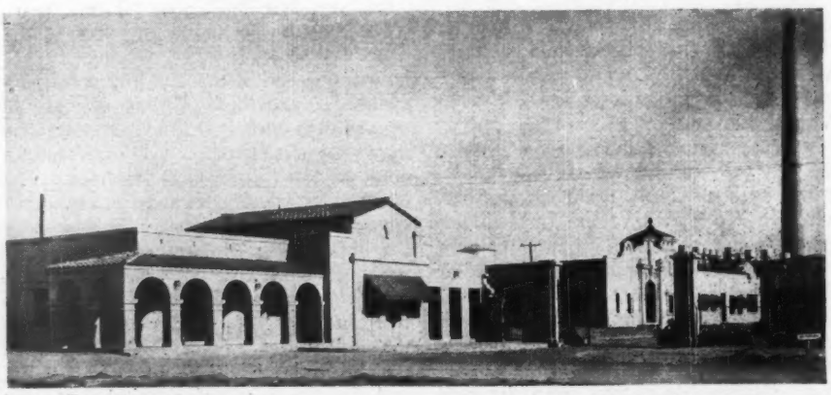
Speed reducers. Jones worm-gear speed reducers—W. A. Jones Foundry & Machine Company, Chicago. Hydraulic variable speed transmission—The Waterbury Tool Company, Waterbury, Conn.

Valves—Chapman Valve Manufacturing Company, Indian Orchard, Mass.

Motors. Motor equipment in the plant supplied by Westinghouse Electric & Manufacturing Company.

Gas burners. Special type burners for refining furnaces supplied by Tate & Jones, New York.

Assay office and laboratory. Hood, and other equipment with Monel metal fittings—Laboratory Furniture Company, Long Island City, N. Y. No. 5 muffle furnace—American Gas Furnace Company, Elizabeth, N. J. Five assay balances—Wm. Ainsworth & Sons, Denver, Colo.



Time office and administration building

Platinum in the Transvaal,

Cape Province, and Southern Rhodesia

A Review by Dr. George Frederick Kunz of an Important Book on the Subject

BEFORE the discovery of platinum in South Africa its occurrence was well standardized. Aside from that secured as a byproduct in the treatment of the ores of other metals, particularly nickel and copper, none was obtained from ore mined *in situ*, recovery being only in the native state from alluvial deposits. The pure metal was seldom found, the platinum being almost always alloyed with other metals of the platinum group and with iron, and sometimes with gold, copper, nickel, or cobalt. Aside from these native alloys, only two minerals were known: sperrylite, an arsenide of platinum, and laurite, a sulphide of ruthenium and osmium, and these very rarely.

In the South African deposits, platinum has for the first time been found in ores *in situ* in sufficient quantities to justify the regular treatment of the ores for their platinum content. In addition to the native alloys present in the ores, large proportions of platinum and palladium are present in a colloidal state, as well as in compound minerals; single crystals of sperrylite up to 33.75 grams in weight have been found, several hundred times larger than any previously known, and two new minerals have been identified: cooperite, a sulpharsenide of platinum, and stibiopalladinite, a palladium antimonide. The ores of the Potgietersrust field are particularly rich in these complex minerals. Those from Lydenburg and Waterberg show mainly the alloy minerals.

THE subject is treated in a new volume* that covers primarily the deposits of the Transvaal, but also discusses those of Cape Province and Southern Rhodesia, because of their geological relationship to the Transvaal occurrences. The appearance of this book is opportune, coming as it does at a time when the status of the platinum industry of the world is in such an adjustive condition, and all those interested in the subject will welcome this unusually careful and elaborate exposition of the South African situation. The story, as told by Dr. Wagner, is a tribute to the abilities of Dr. Hans Merensky for the part he played in the opening up of these deposits, for it was he who discovered both the dunite deposits and the Merensky Horizon in the Lydenburg district, as well as the most important deposits in the Potgietersrust area; and it was he who finally succeeded in locating the Merensky Horizon in the Rustenburg district after others had abandoned all hope of finding it.

BEFORE taking up the discussion of the South African deposits in detail, Dr. Wagner briefly describes the sources of supply, the properties and uses, and the range of prices of the metals of the platinum group. South Africa has for several years been the leading producer of osmiridium, and since the discovery of platinum, and the beginning of the industry in 1925, has reached third place as a producer of the platinum metals, being exceeded in output only by Russia and Colombia. Canada had for several years taken third place with the platinum metals recovered as a byproduct from the treatment of nickel ores, but yielded third place to South Africa in 1927.

The platinum deposits of South Africa are outstanding in the variety of their occurrence. Chemically they are found associated with both acid and basic rocks, and in both native and compound form; mineralogically they are associated with all types of deposits—clays, sands, river gravels, marine beds, limestones, shales, sandstones, quartzites, conglomerates, and a variety of others. Geologically they are found in rocks of all ages, from the youngest to the oldest. Geographically they occur in a well-defined band, reaching from the restricted area of the Insizwa Range in eastern Cape Province, north and east through the Black Reef, the Witwatersrand gold field, the norite zone of the Bushveld Igneous Complex and the Waterberg district of the Transvaal, and on through the length of the Great Dyke of Southern Rhodesia—a total distance of about 1,000 miles, giving what the author designates as "a great *platinum belt* that cuts indiscriminately across the oldest and youngest geological formations, disregarding geological structure and structure lines in the more superficial parts of the earth's crust."

According to Spurr's conception of "ore canals," there should be a great platinum canal that from earliest times has facilitated the upward transference of the platinum-group metals from the rich underlying zone to the rocks of the overlying crust. Dr. Wagner predicts further discoveries of platinum along the course of this canal.

THE platinum occurrences in the ultrabasic and basic rocks of the Swaziland system and of the Black Reef and the Rand are dealt with, but the bulk of the discussion is concerned with the details of the deposits of the Bushveld Igneous Complex, associated with dunite, hortonolite-dunite, olivine, olivine-dunite, chromitite, magmatic nickel-iron-copper sulphides, and particularly with the norites of the Merensky Horizon. Six pages are devoted to the Great Dyke of Southern Rhodesia, eleven pages to other occurrences in South Africa, and three pages to eluvial and alluvial deposits.

Dr. H. Schneiderhöhn, of Freiberg, has contributed a most interesting and instructive chapter on the mineragraphy, spectrography, and genesis of the Bushveld ores. This includes an account of 11 specimens from the Rustenburg district, 17 specimens from Lydenburg, and 66 specimens from Potgietersrust; mineragraphical observations on the occurrence of the platinum-group metals in the nickel-pyrrhotite-bearing rocks of the Bushveld Igneous Complex; a detailed description of the mineragraphy of sperrylite and the two new minerals, cooperite and stibiopalladinite; an account of the examination of various specimens for platinum metals by means of the quartz spectrograph and ultraviolet light; and a summary of results and conclusions as to the genesis of the ores, giving their history through the

*The Platinum Deposits and Mines of South Africa. By Dr. Percy A. Wagner. Edinburgh: Oliver & Boyd. Pp. 326; illus. Price 21s.

four phases of their formation: first, the earliest crystallization of such minerals as chromite and magnetite; second, the separation of the liquid-sulphide melt from the silicate-oxide melt and the crystallization of the sulphides; third, the crystallization of the residual solutions; and, fourth, liquid exsolution-segregation and magmatic formation. During the second of these phases the platinum metals entered into the space lattices of the iron-nickel sulphides, and crystallized with them; during the third phase the temperature was too low to permit this, and this stage is characterized by the separate crystallization of the minerals sperrylite, cooperite, and stibiopalladinite.

The discovery of the South African deposits gave us, for the first time in history, a lode material containing sufficient amounts of the platinum-group metals to justify the mining and treatment of the ore for the recovery of these values. This presented new problems in mining, ore dressing, and metallurgy, the difficulties of which were of increasing magnitude in the order named.

From the standpoint of the mining engineer, the deposits fall into three main classes:

1. Small, almost vertical dunite pipes of the Lydenburg district.

2. Big, irregular, steeply dipping lenses of the Potgietersrust district.

3. Relatively narrow and extensive tabular orebodies, with low to moderate dips, on the Merensky Horizon in the Rustenburg and Lydenburg districts.

The main problems involved in the handling of these types of deposits were soon solved, and satisfactory mining methods evolved at moderate working costs.

THE peculiar character and the wide variety of the forms in which the platinum metals are present in the ores made the problems in ore dressing and metallurgical treatment much more difficult, and only within the last year have really satisfactory methods been developed. The more important of the metallurgical processes that have been proposed are the following: the Onverwacht, which depends on gravity concentration and amalgamation; the Enzlin-Eklund process of amalgamation in the presence of activating agents; the Rand Mines process, involving flotation, chlorination, and leaching; and the Chemical & Metallurgical Corporation's chlorination process. Several other processes or modifications have been proposed, some of which aim at the complete recovery of the platinum metals. Others are merely concentration processes, and the concentrate produced is shipped to some other plant for treatment.

In 1925 and 1926 it was freely predicted that, by 1928, South Africa would be the leading platinum producer of the world, but, owing chiefly to the unprecedented difficulties met in the metallurgical treatment of the ore, this has fallen far short of accomplishment. The 1928 output of platinum-group metals, exclusive of osmiridium, was 23,600 oz., and sales for the year amounted to 17,828 oz. Sales for the first eight months of 1929 were 10,949 oz., or somewhat under the 1928 level. The difficulties of the past four years have weeded out the weaker companies, and have forced the survivors to put their operations on such a basis that future development will be on a much firmer footing. Another year should give a good indication of the real possibilities in the industry. Although the Onverwacht mine is exhausted, and the plant is to be closed about the end of the year, others are progressing satisfactorily in both development and construction work, and by the end of 1930 it is estimated that the plants now under construction will give the Union a potential capacity of over 100,000 oz. platinum metals per year.

THE next question to be determined is how much South African platinum the world can absorb, and at what price? Although the production costs in South Africa vary considerably from plant to plant, they are mostly between £6 and £8, leaving a comfortable margin between costs and the present price. But to secure a market for anything like the maximum output will mean strenuous competition with Russia and Colombia and from increasing quantities of by-product platinum metals from Canadian nickel ores. To accomplish this by means of a price war would mean the loss of much or possibly even all of the profits of all producers for several years to come—that is, a definite assurance of heavy losses, with no adequate assurance of eventual corresponding gains. The only other alternative is an international co-operative restriction of output at a stabilized price. There seems little prospect of accomplishing this, particularly since, in 1927, Russia broke away from the selling syndicate because her output was too much restricted by the syndicate, and sold 100,000 oz. at about the same sum which would have been received from the syndicate for two-thirds that amount. It may be, though, that the country that produced a Diamond Syndicate that has successfully maintained its existence throughout the strenuous periods that have faced it during the last twenty to thirty years may find a solution of this similar but possibly more difficult problem.

In any event, it is not only desirable but necessary for the further development of the platinum industry in all countries that the present rather limited demand for the metal be expanded by the discovery of new uses or the expansion of old ones. Russia already has a Platinum Institute, for the promotion of the uses of the platinum metals, and Doctor Wagner advocates the appointment of a committee of scientific and commercial men in South Africa for the same purpose, the necessary funds to be furnished by the government and the mining companies controlling the industry. He also suggests that in the event of international agreement and the stabilization of the price of platinum at a fixed figure, it would be possible for central banking institutions to build up platinum reserves, against which notes could be issued. The stock of platinum thus accumulated would be of great value in an emergency, as is evidenced by the fact that Russia's financial rehabilitation after the revolution was largely due to the skillful use of her reserves of platinum.

DURING the boom days over fifty companies were floated to exploit the deposits of the Bushveld Igneous Complex and the Waterberg district, of which Doctor Wagner lists ten as still in existence. A small part of this reduction was due to the consolidation of companies; some transferred their activities to the more favorable Rustenburg district; others have been forced to suspend operations for lack of funds; and many were merely exploitations without any real prospects behind them, and soon dropped out of sight. The ten remaining companies, one of which is slated for suspension in the near future, have a total capitalization of over $20,000,000. Three treatment plants totaling 300 tons per day are in operation; and three more, totaling 800 tons' capacity daily, are under construction. Several of the companies are still in the development stage. The largest one of the group is Potgietersrust Platinum, Ltd. Since its absorption of several smaller companies, it accounts for nearly half of the total capitalization. Up to the end of 1928 this company had produced nearly 20 per cent of the Union's total output, but inasmuch as these ores run high in palladium, less than half the output was platinum. The capacity of the present plant is about 4,000 oz. annually, and the new plant nearing completion is expected to produce about 26,000 oz. each year. Although two or three of the companies have blocked out reserves totaling over a million tons of ore, most of the companies have not progressed far enough in their operations to know what their reserves are.

P.S. I have learned with deep regret of the death of Doctor Wagner, who was stricken with typhoid and died on Nov. 11, 1929. He was one of the most talented men who have ever visited the great southern part of South Africa. He had just entered into a contract for five years to do mineral surveying, after having been director of survey and doing much original work.

Progress in Cyaniding and Ore Dressing

WITH COMMENTS on mining investments and other subjects by a past president of the Institution of Mining and Metallurgy, the founder of the Cyanide Club, a pioneer in the application of the cyanide process, and the author of yearly letters to the profession that have stimulated interest and advanced operating technique.

Alfred James

THESE LETTERS were started by an alert, energetic, optimistic technician, able to rely on men of his own selection and training for information supplementing his own as to improvements in practice. As years have passed, the circle of correspondents has widened far beyond that of The Cyanide Club. In bringing forward problems of interest, and particularly in discussing improvements in practice likely to be generally adopted, I have endeavored to elicit correspondence—not anonymous recrimination, but helpful and constructive criticism.

Among other matters I have dealt fully with *filtration.* I went to the extent, in my letters for 1908, 1909, and 1910, of noting each type of filter successfully brought forward, and the recovery we might expect to obtain in practice therefrom. Have we made no improvements for the last twenty years? Recent practice in Mexico and Ontario, as well as that now adopted by Anaconda, of supplementing a filter of one type by the addition of another of a different type, has seemingly confirmed my former strictures and leads me to restate my original position, which was that the best filter for thorough-wash was the hand-worked Dehne, and that the best vacuum filters at that time were the type used at Waihi and the original Ridgway of Western Australia. In my efforts to induce the general adoption of vacuum filtration I was much hampered by the efforts-at-law of the representatives of the Moore interests. Until these were disposed of by the judgment against them in Australia I pushed wholeheartedly the Ridgway filter, which acted as easily and smoothly as the "Waihi." The Ridgway filters and Dehne presses together were responsible for the biggest annual output on earth obtained from the treatment of gold-ore slime. Having regard to the fact that the Dehne presses and the Ridgway filters proved themselves capable, in one operation, of treating at Kalgoorlie solutions of the highest grade ever regularly filtered in practice on a large scale, it seems a reversion to inferior practice that Anaconda in its new zinc mill should find it necessary to install two filters to do the work of one. Formerly I carried a hand-made gold turnip chronometer, accurate and bulky; but for many years now I have relied on a mass-production Waltham, no less accurate and yet pleasant to look on. But I don't have to carry two watches to get the correct time!

I have sympathized with American unwillingness to adopt hand-operated Dehne presses, but is it not paying too heavy a price to have two filters to do the work of one! Have we no filtration enthusiasts today? Is no one coming along to give us what we had in the hand-worked Dehne—a 99 per cent efficient thorough-washing press? Why does no one now publish results of the recovery by filtration on known quantities of dissolved silver and also of salt, such as Marriner and I worked out over twenty years ago?

The efforts and improvements made by Oliver with his revolving drum

Camels drawing firewood on the road to Wiluna, Western Australia's newest gold mine

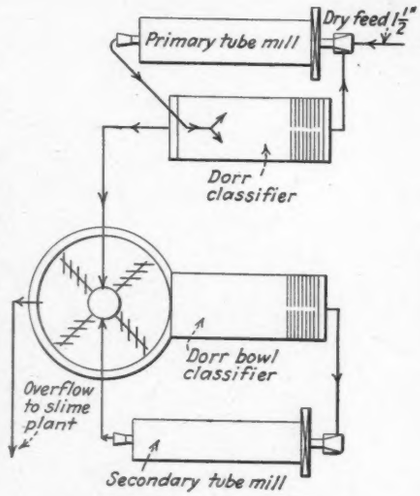
filter so impressed me that three years ago I thought we might place it first among present-day, thorough-wash filters; but experimental investigation then being carried out did not permit me to go so far. I am interested in the evolution of Dorr's latest filter. Burt had a considerable success with his filter at El Oro, and at the Guadelupe test it was shown to yield the highest recovery; but a filter working under blind conditions is not altogether desirable for thorough-washing, and Dorr may be able to show as high recoveries at leaf-filter costs.

ANOTHER subject which gives me serious concern is *roasting*. Why should Australia have lengthened and again lengthened its furnaces until supplementary fireboxes have to be installed along the hearth? Why should America, on the contrary, place faith on a number of small superimposed circular hearths, which must cause considerable dusting? The probable answer is that the Edwards furnace is used for "dead" roasting, and the MacDougall for calcining copper and zinc concentrate down to a certain tenor. Having regard to the very fine grinding now carried out on base-metal ores, as well as on gold quartz, are we to come back to our old original Brunton calciner, venerable with antiquity in its service to tin mines? The many-hearth modification of this calciner, such as the "Barrier" furnace, may be superior for the roasting of zinc and other concentrate in which well-nigh absolute elimination of the sulphur content is neither desired nor required; but a considerable amount of chloridizing roasting is being carried out by American technicians, and a symposium of their practice, with free discussion, would be of great value to the profession. Why do we hear so little of Holt-Dern? In Bolivia, undoubtedly, this furnace has adherents, and I note that at Machacamarca the erection of the Holt-Dern led to the shutting down of the MacDougall furnace so long as material of suitable tenor of sulphur was available for the former; but it looks now as though the Holt-Dern were shutting down and the MacDougall once more being relit, in spite of the special Merton (Australian type) furnace described in the *Transactions* of the A.I.M.E., Vol. 64, p. 864, and further improved as each new furnace was constructed.

IT may well be that, in the future, blast roasting will perform much of the work formerly done in furnaces of the long-hearth, multiple-hearth, and superimposed circular-hearth types; but for dead roasting of minus-200-mesh material, I repeat, are we to come back to the small through-put of Brunton calciners, with chrome-steel uncooled rabbles, or adapt the latter to shorter Edwards duplex roasters?

If the technicians of a country will not describe and call attention in the technical press to their practice, the profession and its employers are apt to regard that practice as no longer up to date, and the pioneering of better practice, with the ultimate control thereof, falls into the hands of a country where technicians are more keen on describing their work.

The late James Douglas was the apostle of free interchange of experience in technical work. Who does not remember his account of his adventure at secrecy-ridden Swansea? Has ever downfall been more complete than that of the copper industry there? For many



Fine grinding with tube mills at West Springs, on the Rand

years America has led the way in describing her work in the metallurgy of copper, lead, and zinc, in flotation practice, and in mining geology. Can one be surprised if the control of the exploitation of the above metals, as well as of the metallurgy thereof, has passed into American hands, and that other countries employ and are employing American technicians in preference to men of local training.

FORMERLY the Cornish miner was predominant in most extra-European mining territories. With the development of new mining systems in America, of which we find from time to time full descriptions in American technical literature, pre-eminence in actual mining passes from Cornwall to America, and it is American engineers who are being imported for the layout of mines, not only into South Africa but even into Australia. What have the Cornish miners been doing all these years?

The British Empire still leads in the mining of gold. Possibly alone among the processes of this generation the cyanide process may be regarded as having been competently described and fostered from that country. Indeed, it seemed to me when looking into the matter some little time ago that well-nigh every writer of note on the metallurgy of gold was either born an Englishman or had received his training in an English-owned mine, or at least from a metallurgist employer trained in an English mine. Anyhow, the fact remains that the English are still dominant in gold production. But the birthplace of flotation has been remarkably silent as to its development and practice, and the glory of epoch-making achievement is due to America and to Broken Hill.

I feel every reason for cheery confidence in our continued progress, but if London and Johannesburg (Anglo-American group excepted) and Kalgoorlie and Mysore will not contribute freely to the profession their improvements in practice, may we not expect to lose even the place we have—or what is left of what once we held?

Fine Grinding—In my last year's letter and later (see *Engineering and Mining Journal* of May 25, 1929), I refer to the continued good work of Willey and Ewing at West Springs. I am now in a position to give still later results. The adoption of stage tube-milling has improved the previous good output at a proportionately lower cost and slightly reduced power consumption, with an increased recovery of 7.45d. per ton.

The work at West Springs makes history. At the outset the proposition was to do away entirely with the stamp mill; not merely to replace stamps by rolls, as frequently attempted in the past, but to throw onto tube mills the work previously accomplished by stamps. The success of this proposition as carried out by Davis and his associates is surprising. A feed similar to that sent to stamps was fed into tube mills, with entirely successful results. An output was obtained of 200 tons per tube mill per diem, yielding to screen analysis 80 per cent minus-200 mesh.

However, the minus-200 product in classifier oversize carried an abnormally high gold content (see the paper read before the C.M.,S. on Oct. 23, 1929), and that indeed this material contained a surprisingly large proportion of the total residual gold: further comminution was required to release this gold. As West Springs had already reached its economic limit in grinding the whole ore to 81 per cent minus 200, the only thing to be done was to separate out this valuable residue and to carry out further comminution on this only. The desired separation was effected by Dorr bowl classifiers, and the regrinding of the selected material at once reduced the residues by 0.10 dwt. As a result. the plant of twelve tube mills and accessories designed to treat 60,000 tons in a 26 working-day month is found to handle 65,000 tons with ease in a 27 working-day month.

At present nine tube mills are run as primary mills and three as secondary;

large "pebbles" (see *Engineering and Mining Journal,* Dec. 22, 1928) being used in the primary and minus-1½-inch pebbles (reject from the primary mills) plus scrap steel in the secondary. Present indications are that the secondary mills will work efficiently with reject pebbles alone. After several tests the secondary mills were found to yield the best results when run at the same speed (25.6 r.p.m.) as the primary mills. All are 6 ft. 6 in. by 20 ft.

The result, as noted above, is an appreciable increase of minus-200-mesh product, and a slight but definite improvement in power consumption—now 25.1 kw.-hr. per ton of minus-200-mesh product. The grading of the present product is 81.5 per cent minus-200 mesh, and the total present reduction cost is 2.934s. per ton, as against the old cost of 3.139s.

The figures given in my tabulation last year of the amount of minus-200-mesh product output by various appliances can thus be modified by the addition, after line 2, p. 972, of "African practice, 1929, Davis et al., minus-200-mesh product, 66.62 lb. gross per horsepower-hour." By the courtesy of the authors I am able to illustrate herewith the layout of the plant for stage regrinding.

In congratulating all concerned on the successful accomplishment of the task to which West Springs had set itself, I would wish once more to repeat that "Our ideas as to the limitations of the tube mill seem to require revising."

The announcement, in the *Engineering and Mining Journal* issue of Oct. 5, 1929, that at Loreto they are cutting down their 16-ft. and 20-ft. mills to a length of 10 ft., interests me all the more in view of my comment last year—that all the high results, save one with ore not of our type, were from short tube mills. I feel that long tube mills need defending. Or is it that one has to revise the output of long mills and pebbles as against that of short mills and balls?

Slime Leaching — The announcement that at Inspiration it has been found desirable to classify the material and to treat the fines separately in a special agitation plant reminds me of the debt of base-metal metallurgy to our practice in gold and silver. For some years copper has laid itself out for mass leaching in tanks and *in situ*, and able men have devoted themselves to facilitate the even permeation and percolation of bulk charges. I have watched these efforts with admiration, but have not written about them. My earliest ideas were to leach the Rand tailing dump *in situ*. In my letter for 1904 I described with some detail and criticism the efforts of George Stark on the dump at the Crown Reef. But ever and again, after spells of sundrying, with and without ploughing to break up colloids, the industry always came back to classification into a clean sand for percolation and a slime to be treated in Pachuca tanks. The investigations carried out at Inspiration and the resulting high extractions (see *Engineering and Mining Journal,* Oct. 26, 1929) demonstrate yet again the great advantage of this practice.

To our work in gold metallurgy the base-metal industry owes big vats and tanks, tube mills, vacuum filters, and Pachuca tanks as well as Dorr settlers and classifiers, or all that makes feasible the leaching of slime.

Flotation—I commenced my letter of last year with a reference to the success of simple flotation on the gold ore at Wiluna. Recent results from the Châtélet Gold Mines are even more encouraging: by using butyl alcohol, sodium sulphide, and cresylic acid—and no xanthate—a 95 per cent extraction is obtained in an 8 per cent concentrate. About 600cc. of a butyl wash product, 100cc. of cresylic acid, and 1 k. of sodium sulphide are used per ton. Owing to the presence of pegmatite and chlorite in the ore, the tube-mill product is extremely basic, and the consumption of sulphuric acid is heavy, at times as high as 30 k. per ton. The gold is intimately associated with arsenical pyrites, and grinding has to be carried to 90 per cent minus-200 mesh.

Results are being improved all the time. Those for October show a flotation recovery of 96 per cent with a high grade of concentrate (250 grams per ton), a cyanidation recovery of 97 per cent, and a total extraction of 93 per cent. I have known the Châtélet mines for many years. The refractory nature of the ore and the enterprise and skill of the technical management result in probably the most up-to-date equipment of any gold mine in Europe. M. Leon Benett, the general manager, is to be congratulated on his success. He has accomplished what will prove an incentive to much experimental investigation elsewhere.

For a whole generation I have written on cyanide practice, with ore preparation and treatment as sequels; it would seem fitting now to include a word of suggestion, or of warning, regarding—

Investments—Our old friend W. A. Caldecott, before he died, rendered us a service by his article in the *S.A. Mining Review* of November, 1924. In this he pointed out the three periods of a man's life—enterprise and initiation, accumulation and consolidation, guardianship and security. He showed that while young and earning money a man could take risks, but that, as he grew older and his power of recovering losses became less, risks were to be avoided in favor of bonds.

At about the period of the Caldecott paper I was interviewing an aged and very wealthy mine owner, the control of whose mine I desired to acquire. To an offer involving a cash payment in seven figures the old gentleman exclaimed "But what shall I do with the money? I could not sleep at nights as a Rentier!"

His remark set me thinking. I had looked on bonds or consols as the safest and soundest investment (except possibly the purchase of good freehold in London or other suitable capital city) one could make. What reason, then, could my friend have for being so sure that his money was safer in a mine!

The adventurer who wishes to invest his accumulated fortune, or the business man his savings, may well examine the return offered by investment in some of our best-known mines, but only in those of which full development data are regularly published. This enables him to judge if satisfactory provision can be made for the amortization of his investment.

A mine differs from a local loan or a debenture stock in that it is a wasting asset, and any purchase of shares should be for a definitely limited period. On the other hand, unlike other first-class investments, a mine may yield a high rate of security as well as of interest if from the dividends as received one reinvests such a sum as will return intact the original outlay.

Some years ago, on best advice, a professional institution invested in consols. It has now lost nearly one-half of the capital invested. Subsequently, the same institution purchased more government, dominion, and London County Council consols and stocks. These investments show a loss of one quarter of the capital invested. Interest also has been low. The point is that at the time of the second investment the purchase was urged of Crown Mines 5 per cent debentures. The suggestion was derided. Had it been followed the invested funds would be today 27 per cent better off. The market value of the debentures appreciated until paid off at a premium; meanwhile they continuously paid a higher rate of interest.

Mines, for investment purposes, may be subdivided into prospects, producing mines, and investment mines. They should also be classified according to territory. Thus mines in certain countries can scarcely be regarded as investment propositions, owing to the encouragement afforded to strikers by partisan or weak governments, on which labor or communism has established such a grip as to predicate the industrial ruin of these countries. Mexico with all her revolutions proves more attractive for mining operations than either England or Russia.

Prospects and producing mines are for the adventurer—preferably for him who can assume control. An investment mine is one with a regular dividend record and a calculable life. It may be

purchased more cheaply than a producing mine, because its future is so well determined that it no longer attracts the gambler—who has nothing to go for—and thus its shares languish until from twice the actuarially calculated present value its market value depreciates to present value or even lower. This is the investor's opportunity.

Investment mines, once established as such, are likely to have a remarkable record of permanence in price, following the gradual appreciation consequent on the recognition of the attainment of investment basis. Thus, in 1912, New Modderfontein shares stood at £13, thereafter gradually appreciating to 27¼, when they were split—eight shares for one or 68/1 each. Today the price is 92s. 6d. What government stock can compare with the steady appreciation and the settled price of these ordinary shares over the same period?

investment shows, on an outlay of £10,000, a spending income of £1,100 a year, income tax paid, with full actuarial provision for the redemption of capital at the closing of the mine? Emphasis, however, has still to be laid on the "shrewd." Just as an investor in the loans of Japan, Brazil, and Australia carefully watches developments in these territories, so one needs also closely to watch the developments in his mine.

I included the list given because I acted on it within 24 hours. An income of over £1,300 was assured from an investment of £10,000 in more than one of the mines given above. How often in a lifetime can one buy into the gold mine of the world below its actuarially calculated present value! My investment was well chosen. Within twelve months I saw a 60 per cent appreciation on my capital, in addition to the plus 13 per cent income derived from dividends.

Six high-class and scientifically selected mining-company securities that yielded an annual income of more than $5,000 on an investment of $50,000, contrasted with the income from British Savings Certificates

	Annual Income	Net Spending Income
War Savings Certificates @ 15/6 = 12,903. In ten years = 12,903 × 26/– = £16,774, or £6,774 profit, or	£677½	
National Savings Certificates @ 16/– = 12,500. In ten years = 12,500 × 24/– = £15,000, or £5,000 profit, or	£500	
The above assumes that no yearly dividend is drawn. The result shown is the lump sum received at the end of the certificate divided by 10. If an annual income is drawn on National Savings Certificates, the net spending income per annum is—		£450
Crown Mines shares at 52/– yield 3,846 shares with dividend at 7/–	£1,346	
P.V. (life 38 years) = 76/. R. £116 = £1,230, less tax at 2/– leaves		£1,095
P.V. with 6/– div. = 65/6; spending income £927.		
Geduld shares at 3½ yield 3,200 shares with dividend 6/9	£1,080	
P.V. (life at 850,000 tons yearly = 74/6 = 40 years) £1,080 — R. £105 = £975—tax £108, leaves		£867
Modder Deep shares at 43/– yield 4,560 shares with dividend at 7/–	£1,627½	
P.V. (12 years' life) = 49/–. £1,627½ less R. £665½ and tax £163, leave		£799
New Modder shares at 91/– yield 2,200 shares with dividend at 12/–	£1,320	
P.V. (life 17 years) = 98/–. £1,320 less R. £422 = £898, less tax £132		£766
Robinson Deep A shares at 21/6 yield 9,300 shares with dividend at 3/–	£1,395	
P.V. (life 13 years) = 21/6. £1,395 less R. £625 = £770 less tax £140		£630
Springs Shares at 48/6 yield 4,120 shares with dividend at 6/6 per share	£1,339	
P.V. (life 45 years) = 75/–. £1,339 less R. £75 less tax £134, leaves		£1,130

The accompanying table, computed in September, 1925, shows the position then of certain mines, as against that of National Savings Certificates, the best and safest British government investment. "P. V." is the actuarially calculated present value (8 per cent dividend, and investment for amortization at 4 per cent). See tables in Herbert Hoover's book "Principles of Mining" (McGraw-Hill Book Company), in which R = the amount set aside for redemption of capital.

In the accompanying table are omitted those mines which were quoted above their actuarially calculated P.V. There seems no object in calling attention to their possibly too-great appreciation by the general public. Their price was too high for the purpose of our investment.

The attractiveness of certain South African shares to shrewd investors was the feature of these notes. What other

The above experience made me much more appreciative of the old gentleman's preference for a good mine rather than for government bonds as security for his money. I began to look around to see what mines other than some on the Rand could be measured up as assured investments, either because of their huge tonnages blocked out, or of their being themselves blocked out, as it were, by the development of their neighbors on four sides, such as New Modder and Modder Deep, for example.

It seemed to me that certain tin mines in the Malay States, in addition to the copper mines so well known in America, possessed the desired safeguard of accurately valued reserves. Tin, however, has a risk we cannot associate with gold—a highly fluctuating market price. Given the security of the value of the measured deposits—they are usually mines in name only, being detrital deposits worked by dredges, gravel pumps, or by hydraulicking—how can one provide for a variation in the price of the metal, say, from £183 to £321 per ton? The answer is that the price is found to move in a series of cycles of rise and fall, because consumption ever and again outruns production, with consequent depleted stock, and such famine prices as induce the opening up of high-cost production to provide adequate supply. The reaction between high price and increased production is by no means instantaneous. On the contrary, it takes about two or three years for the famine price to induce the production of extra tin from new sources. The result is that the new tin falls on a market that has already slumped in anticipation of great supplies from the many boom-begotten new enterprises. This is the consumers' great opportunity. At every slump a greater demand for tin sets in, and once more even the new production becomes too small to supply the increased demand. Production always fails to reach expectations, owing to the dropping out of the uneconomic newborn enterprises, some frightened out of existence even before production is reached, by the slump from the boom price to which they owed their conception.

The above cycle takes almost seven years. So the old tin investors buy at every slump and sit tight. When they die the one trouble of their executors is the amount of money they suddenly have to find to pay death duties on such large estates!

Now that the attractions of investment in the best tin mines in Malay are becoming widely known, it has been interesting to watch the movements of shares during the great 1927-29 slump. In spite of the fall in the price of the metal, from £319 to under £180, the shares are in many cases at higher values than their highest in 1927, when tin was at £319 per ton.

I have written of tin because much of my work for the last five years has been in connection with tin mines. If I have shown that the old gentleman was not so very wrong in his preference for a good mine rather than for a bond, do not let that cause you to invest in any mine until you have put your slide rule over the position for yourself, obtained reliable information from some confrère who knows the mine personally, and taken into full consideration that a mine is a wasting asset, so that ample provision must be made for the redemption of capital thus invested within a definite period. One last warning: Do not put all your money into mines. Always have a proportion so placed that it can be immediately realized, without loss, to meet unexpected emergency. All investments are apt to run in cycles of high and low quotations. Why be forced to sell when prices are low and few buyers are about?

The Mining Bank of Chile

Embarks on Definite Subsidizing Program

Fernando Benitez

Technical Advisor to the Caja de Crédito Minero

AFTER the work of organizing the personnel—technical, legal, and administrative—which the future activities of a credit institution such as the mining bank of Chile (Caja de Crédito Minero) demanded, and equipping the necessary laboratories for assaying and metallurgical tests, it was indispensable to carry out a rapid survey, as thorough as time permitted, of the available mineral resources of the country, actual and potential. Chile lacks a geological survey and a bureau of mines such as the United States or Canada boasts of, so the task was not easy, the data available being mainly confined to the meager and incomplete records found in the government's annual statistics of ore milled, smelted, and exported. Ore milled belonged chiefly to the larger Chilean concerns with substantial mines. That smelted came chiefly from the smaller mines in the central provinces of Santiago and Aconcagua. Ore from the northern ones, in the region of Coquimbo and Atacama, was chiefly exported.

In the last few years the ore production of Chile had been slowly dwindling, owing chiefly to improvement in grade, the low price of copper from 1921 to 1928, and lack of transporting, milling, and smelting facilities. Consistently crooked promoting, which on frequent occasions amounted to barefaced robbery, had added its quota to complete a disheartening outlook for the future prosperity of the Chilean mining industry proper. Although Chile had slowly risen to second place among the great copper-producing countries, this result was due solely to the increment in production of the great American-owned enterprises—Braden, Chile, and Andes. In former years, when Chile held first place among the copper-producing nations, the ores were mined and smelted with Chilean capital and labor.

Data collected from the engineers in the field as to tonnage blocked out and the possibilities of a fairly rapid increase in production were not encouraging. Tonnage blocked out in the mines was almost non-existent, and what was available was mainly confined to the low-grade dumps and fillings left in the mines. Most of these were either under water or absolutely lacking means for transporting, hauling, or efficiently exploring and exploiting the ores. Power was not available either, and, to complete a sad story, most of the railroads that served the old mining camps had been abandoned.

To revive such an invalid, almost in the last stages of consumption—for thus one might describe the state of the Chilean mining industry when the Bank came into being—will not be an easy task. Fortunately, even the miners themselves are beginning to realize now that the Bank represents the last effort to be made by the government to revive the industry. It is the duty of every one to help, and not to ask the impossible.

Up to the present the loans made are as follows:

Sulphur deposit at Ollagüe, Province of Antofogasta: $1,200,000 (Chilean currency), to increase and bring up to date the plant for producing refined sulphur. This is used mainly in Chile for making black powder and for the separation of iodine from the mother liquors in the nitrate plants. This plant will shortly be in a position to supply all Chile's requirements in sulphur and to export a surplus production for use in the vineyards of the Argentine.

El Guanaco, near the port of Taltal: $600,000 (Chilean currency), to build a cyanide plant to treat the old dumps from this small but rich gold field.

Inca del Oro, to the north of Copiapó, Province of Atacama: $405,000 (Chilean currency) to build a 40-ton flotation plant to treat the pyritic gold ores and dumps of the district, worked by the Peruvian Incas before the Spanish conquest.

Elisa de Bordos, in Copiapó: $1,500,000 (Chilean currency), to build a 100-ton cyanide plant to treat the dumps and fillings left in this famous silver mine. The ore will be cyanided by counter-current decantation. Hydroelectric power is available in excess of requirements.

La Higuera, Province of Coquimbo: $1,500,000 (Chilean currency) in the form of successive emissions of bonds up to that sum, the bonds to be guaranteed by the Bank. The first emission will be for $300,000 (Chilean currency), to unwater mines, and to put in sight sufficient tonnage to guarantee the return of the principal with interest for the total sum of $1,500,000, which will be used for the construction of a 100-ton flotation plant. The first emission of $300,000 is guaranteed by securities mortgaged to the Bank by the company against the risk involved by a total loss of this smaller sum in case the exploratory campaign gives unsatisfactory results. Higuera was for more than 50 years one of the most intensive copper-producing camps in the Province of Coquimbo.

Compañía Minera El Pacífico: $2,000,000 (Chilean currency), to modernize and place in operation the old smelter of Guayacan, in the port of Coquimbo. The new smelter will consist of modern reverberatories, but will not convert at first.

La Paloma, Coquimbo: $165,000

(Chilean currency), to finish its 60-ton copper flotation plant now building.

La Laja, Coquimbo: $250,000 (Chilean currency), for the same purpose as the aforementioned. This flotation plant will be a portable one, capable of being shipped elsewhere when the ores are exhausted.

Cambridge: $300,000 (Chilean currency), to exploit a marble deposit in the Straits of Magellan.

Besides these and smaller loans granted to private companies, the Bank is building three 100-ton custom flotation copper plants in the districts of El Salado (Chañaral), Punta del Cobre (Copiapó), and Tambillos (Coquimbo). The flow sheets of the three plants will be similar in their main characteristics, and will consist of Blake primary and McCully finishing gyratory crushers; Allis-Chalmers ball mills in closed circuit with Dorr duplex classifiers; Fahrenwald 12-cell flotation machines and Dorr thickeners, with the necessary accessories. The power will be generated for each plant by two 275-hp. Deutz Diesels, direct-connected to Siemens-Schuckert generators, one set acting as a spare. Excess power above plant requirements will be sold at cheap rates to neighboring mines for drilling, pumping, and hoisting. It is expected that the three custom flotation plants will not be operating within a year, owing to delay in delivering the Diesels. The metallurgical operation of these plants will be interesting, inasmuch as they will treat in the main small tonnages of partly oxidized dump material from many small mines. Each plant will cost about $1,500,000 Chilean currency.

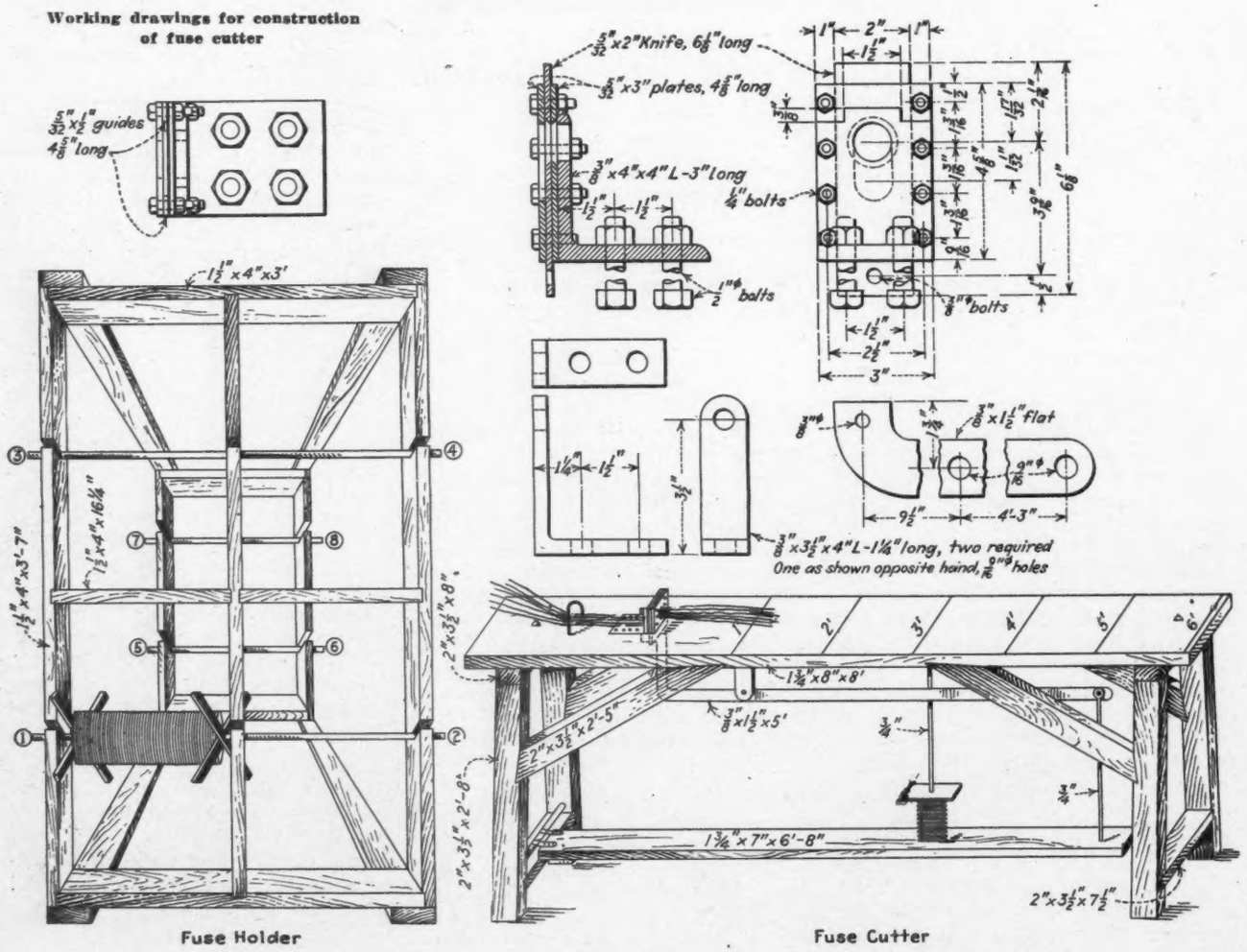
The main project of the Bank will be the construction of a new and modern smelter in Paipote, in the Province of Atacama, near the town of Copiapó. This is estimated to cost $10,000,000 Chilean currency. It will utilize the latest improvements in copper smelting and will take about two years to build. As a subsidiary help to the small miner, the Bank has ordered a few sets of mine pumps, drills, and portable compressors driven by Diesels or gasoline engines, which will be loaned to the small-mine owner at cheap rates. All milling machinery so far ordered by the Bank has been exclusively of American design and construction.

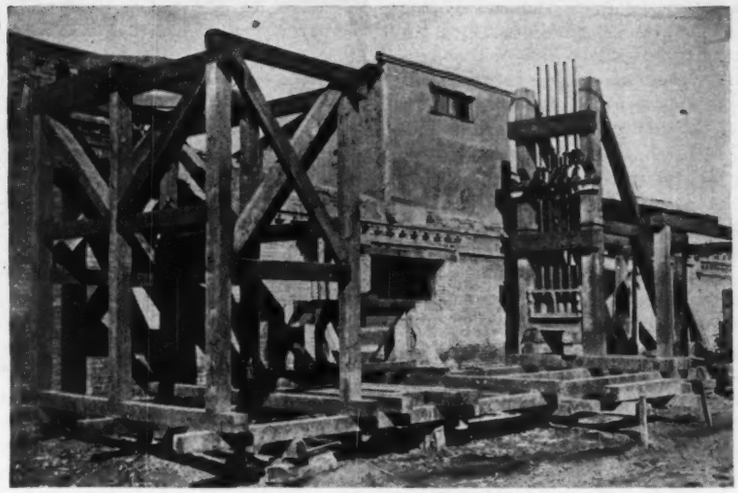
Effective and Economical Fuse Cutter

THE ILLUSTRATIONS herewith indicate the construction of a fuse cutter designed and put into successful operation at the El Bordo mine of the Cia. General de Inversiones Mineras, at Pachuca, Mexico, by J. T. Marks, mine superintendent. The machine, which is inexpensive to construct, will cut from 10 to 15 pieces of fuse at one stroke of the operator's foot, or 100 per minute. It occupies little space. The blades, made from discarded circular-saw steel, are sharpened by retouching with a steel tool.

Among advantages seen in the use of a machine rather than cutting by hand are the following: (1) Uniform length of fuses; (2) economy of time; (3) a square and clean cut is made, making it easy for the operator to insert the blasting cap.

Working drawings for construction of fuse cutter





General view of mill during construction—"machine shop" in background

THE DESIGN *and construction of a small stamp mill usually involves little difficulty. When, however, the scene of operations is moved to Manchuria, and Chinese labor, and to a large extent local Chinese methods also, must be employed, construction problems multiply, and present unusual conditions. Referring to such experiences as peculiar and novel, the author gives an account that will have particular interest for the engineering fraternity.*

Constructing a Small Mill in China

Edwin A. Sperry*

IN DESIGNING and constructing a small stamp mill for prospecting, to be operated in Manchuria, I met with peculiar and novel experiences. The ore comprised pyrite in a calcium carbonate gangue. It carried an average of 2 oz. of gold and ½ oz. of silver per ton. Preliminary tests, with a small laboratory stamp mill, indicated that much of the gold could be recovered by amalgamation, and that a high-grade concentrate could be extracted. Tailing was to be impounded for future treatment by cyanide, a good recovery being forecast. The plant was constructed by native workmen. The amount of drafting was necessarily large, as every part, even the bolts, had to be carefully detailed. Over forty sheets, large and small, were necessary.

One battery of five 500-lb. stamps was considered sufficient for present purposes, to handle from seven to ten tons per 24 hours, this being assumed as a probable maximum output of the mine. The framing was designed to provide for an additional battery of five stamps when conditions warranted.

The first experience of interest was that of sawing out the timbers from logs, as shown in Fig. 1. Almost all the lumber used in construction here in China is cut into dimensions in this manner. No sawmill can compete with manual labor there.

As the mortar could not be cast with the ordinary cast housing attached, the form adopted was that of the old Gilpin County or "hog-trough" type, with iron-lined wooden housings. Even that called for a pour of about 1,300 lb., which was close to the limit by the native method. Melting is done in batches in a bell-shaped cast-iron pot, open at the bottom, mounted on a hearth similar in form to half a pear cut lengthwise, the extended side being used as the pouring spout. The pot, heavily lined with clay, is provided with one tuyère opening at one side and about 6 in. from the bottom. The tuyère nozzle, covered with the clay lining, extends into the pot about 6 in., being deflected downward toward the hearth. Constructed in the form outlined above, the hearth is large enough to hold the batch needed for the pour. The blast is supplied by an ordinary centrifugal fan blower, driven by an electric motor—a comparatively recent innovation. Formerly the blast was supplied by a blower, worked by hand, consisting of a long closed box of square section about twice as long as its width and provided with a piston attached to two rods extending through both of the closed ends of the box. Cross pieces are attached to the outer ends of the rods to serve as handles. Valves are arranged so that the blast is produced by both directions of the stroke, similar to the action of a compressor.

The nozzle is about 3 or 4 in. from the tuyère opening, avoiding direct pressure to the blast. In starting the run, the pot and hearth are filled with coke, wood and kindling being placed at the bottom. This is fired and allowed to burn for a few minutes before a light blast is turned on, increasing in amount as the charge becomes ignited. Blowing is continued for about half an hour, or until the coke is glowing nearly to the surface. When sufficiently

Fig. 1—Hand-sawing of battery timbers

*Department of Metallurgy, Pei-Yang University, Tientsin, China.

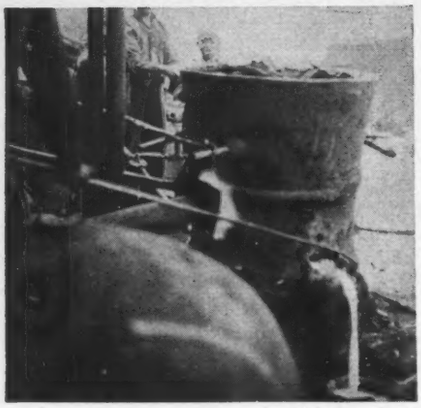


Fig. 2—Pouring a melt from the primitive "cupola"

hot, pigs of iron are thrust down into the coke around the edges of the pot. Melting begins. The quantity needed for the pour is estimated and piled alongside the pot. As soon as the pigs first charged have disappeared, others are thrust in until the batch is melted.

The sides of the pouring spout are level with the top of the hearth, the spout being only about 1½ to 2 in. deep at the end. This opening is kept loosely closed with clay until melting is completed. In making small castings, the pouring usually starts before the batch is entirely melted. If one large casting is to be made, as in the case of the mortar, the melting is first completed.

In the installation here described, the hearth is mounted on trunnions. A heavy bar is inserted in the short length of 3-in. pipe that is cast into the rear end of the hearth, by which it is tilted. The pot, set loosely on the hearth and simply luted with clay, must be steadied to prevent overturning or sliding. This is done by engaging long rods with the two sets of short rods that extend from the sides of the pot by which it is held in place. During the pouring, a shovel is held in front of the tuyère opening, to prevent the blast from entering. The slag is held back by a paddle-shaped rod. Coke used amounts to about one-half by weight of the amount of iron melted. A sketch to scale is shown in Fig. 5. Such a device might be used in an emergency where a foundry is not available. Larger sizes are made, even up to 3 ft. high, with correspondingly larger dimensions.

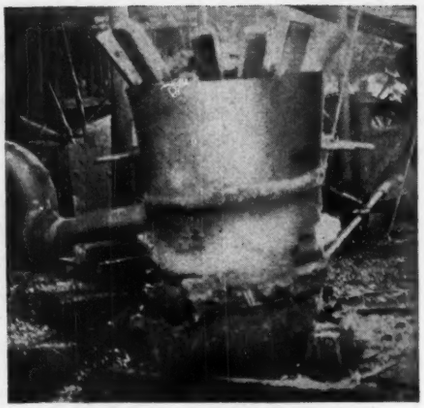
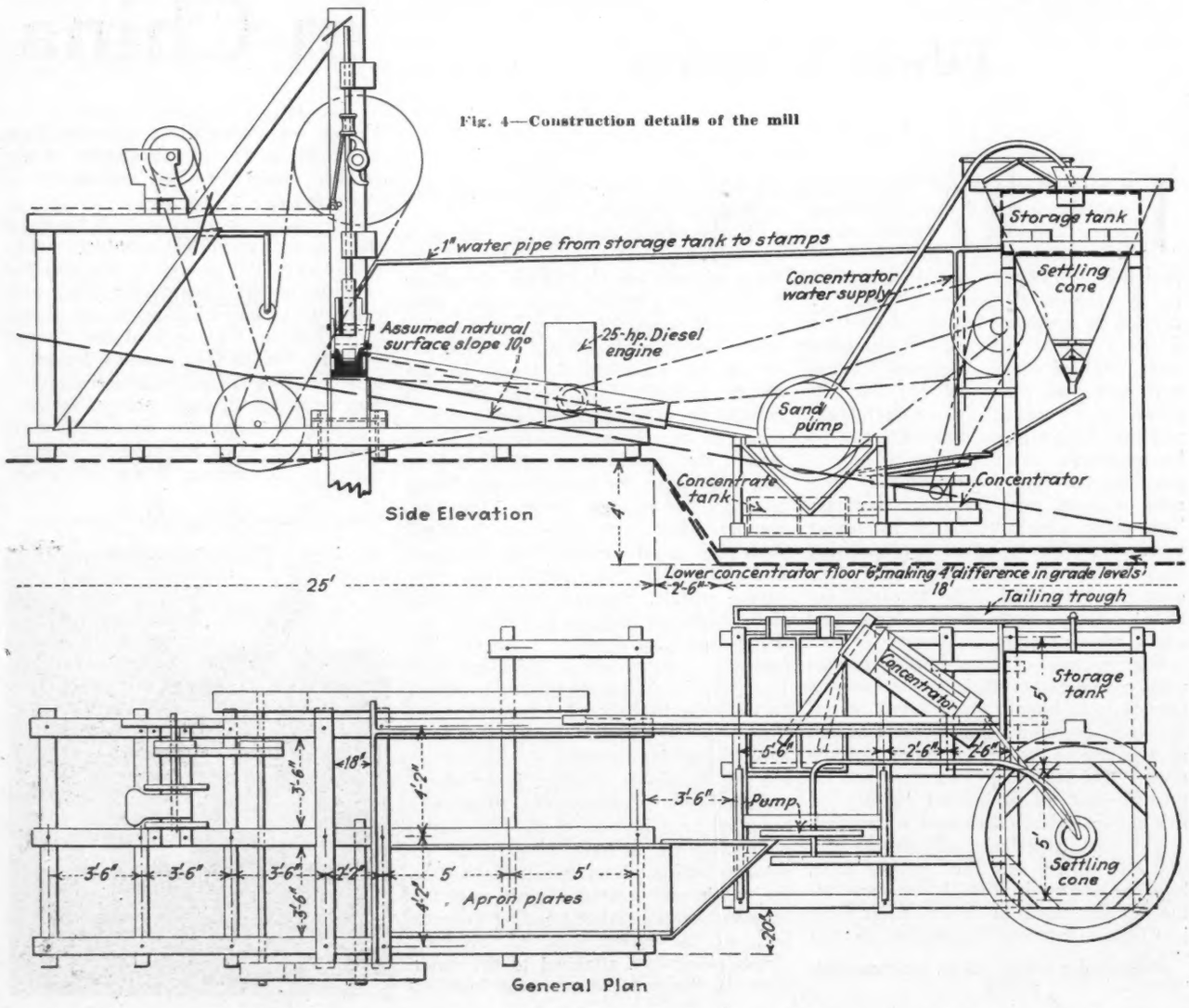


Fig. 3—Melting a charge of pig iron

Small ladles are used in making small castings, as shown in Fig. 2. Fig. 3 shows some of the pigs projecting above the top of the pot. When large castings are to be made, the iron is transferred by the small ladles to two larger ones, each of which will hold one-half of the necessary amount. The large ladles are provided with four circular handles, somewhat similar to those of a teacup, two on each side.

Fig. 4—Construction details of the mill



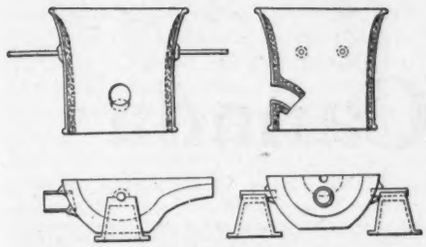


Fig. 5—Chinese melting pot used in melting pig iron

Two long poles are inserted through the two sets of handles, so that the pouring spout is transverse to the length of the poles. The ladles are then carried by coolies to the mold, which in this case was provided with two pouring gates. At a given signal, the two ladles are poured simultaneously until the gates and a central riser are well filled. The operation is carried on through a babel of shouting and chattering which always seems to be one of the essentials of team work with Chinese laborers.

Lathes, planers, and other machines are crowded into a mud-brick shack with dirt floors, which, during the rainy season, is often ankle deep with mud. Even in this confusion, surprisingly good work is turned out, though the operatives are often boys not over twelve or fourteen years of age, working for a wage equivalent to about 25c. gold per day of ten hours.

A dewatering cone, of novel design, 7 ft. diameter and 8 ft. high, was designed for the preparation of the pulp for the concentrator. It is made of $\frac{1}{8}$-in. iron and weighs 1,300 lb. The total cost was about the equivalent of $140 gold. Fig. 6 gives the details of its construction. A central rod is suspended in the cone, to the lower end of which is attached a conical plug, which closes the discharge pipe. A cone-shaped diaphragm is permanently attached to the rod one foot above the plug. About 3 in. above the apex of the cone-shaped diaphragm a spider is placed, through which the rod slides freely, insuring central position. This spider is free from the sides of the cone.

A lever, attached to the upper end of the rod, is actuated by another rod suspended from its outer end. This rod is provided with an adjusting device at the lower end, by which the plug and the diaphragm may be raised or lowered. When lowered, both the plug and the diaphragm are in contact with the sides of the cone, making complete closure. By raising the central rod, pulp is allowed to pass at any desired rate. The rate of flow is principally regulated by the plug, the opening at this point being under better control. Reducing plugs can be applied to the discharge pipe if desired. The device has been tried in the ore-dressing laboratory of the Pei-Yang University and has been found to work satisfactorily. Even when pulp has remained

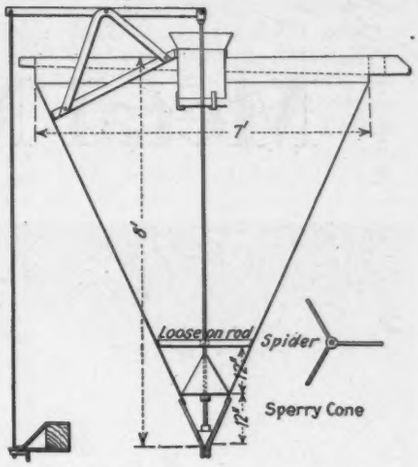


Fig. 6—Dewatering cone—Sperry type

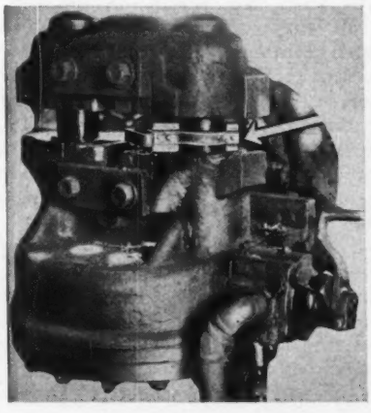
in the cone for a considerable time, and has become packed, the flow can be started with but little trouble.

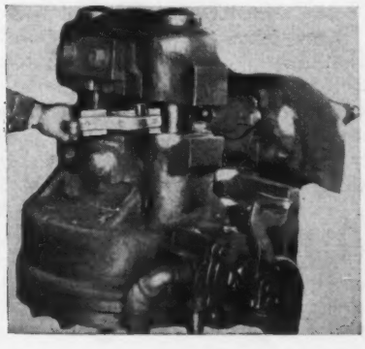
In making the rock breaker, due apologies must be made to the Braun-Knecht-Heimann Company, of San Francisco. One of their "Simplex" laboratory breakers was taken as a model and the rock breaker was made up at twice its size, giving an opening of 4x6 in. The reinforcing ribs of the body casting were increased, and the result was satisfactory. This rock breaker's total weight, including two flywheels, was 1,500 lb. A general plan and side elevation of the mill is shown on the preceding page.

This Device Protects Hands of Drill-Sharpener Operators

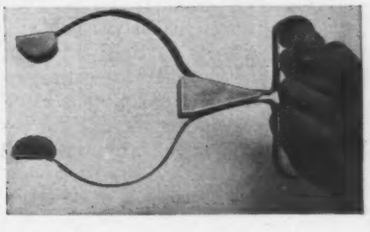
PREVENTION of accidents to persons employed on rock-drill sharpening machines is the object of the spring-clip device shown in the illustrations below. The accidents this is designed to prevent are those due to the hammer head of the machine accidentally coming down on the fingers and hands of the operator, generally while setting or changing the dies or formers, or while cleaning the machine. W. A. Pitts, Mines Department, Krugerdorp, Transvaal, is the inventor of the clip, and the photographs and description are presented here by the courtesy of the Prevention of Accidents Committee, Rand Mutual Assurance Company, Johannesburg.

The device consists of three distance pieces of about $2\frac{3}{8}$ in. depth, arranged and fixed to a light steel spring clip, the blocks forming the corners of a triangle. The clip has a handle sufficiently long to permit inserting the device into position, without exposing hand or fingers to danger. Inspection of the illustrations of the sharpener will demonstrate the method of handling the device. The dimensions can be made to suit the type of machine for which it is intended.





Three mines have tried the device, and the committee has been so favorably impressed by reports that it has recommended its general adoption, wherever practicable. A suggestion has been made that it might be attached to the machine by a chain or other means, so that it may always be on hand and ready for use. No royalty is payable for use of the device.



Metal Mining in Canada

Pack train crossing glacier to Porter-Idaho mine, British Columbia

A. H. A. Robinson

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THE history of the mining industry in Canada is divisible into three well-marked periods: the first, extending from the earliest settlements to the middle of the nineteenth century; the second, covering most of the second half of the nineteenth century; and the third, the present century to date. During the first of these periods there was little active search for mineral, the incentive being almost entirely the need of supplying from local sources as far as possible the wants of more or less isolated communities. Thus, in 1720, coal was dug from outcrops in the cliffs on the Atlantic coast of Cape Breton to supply the workmen engaged in building the fortress of Louisburg—the forerunner of Nova Scotia's present coal-mining industry. In 1737, bog ores were being worked for the production of charcoal iron in a group of forges near Three Rivers in Quebec—a local industry that remained in almost continuous operation until 1882; and during the first half of the nineteenth century a number of small charcoal iron furnaces, all of which had short careers, were built in various parts of eastern Canada to supply local needs from local ores—usually bog ores. A mining enterprise of another type during this period was an unsuccessful attempt to mine copper at Point Mamainse, on Lake Superior, about 1770.

During the second period, which opened with gold rushes in such widely separated localities as British Columbia and Nova Scotia, and with considerable mining activity and excitement in other parts of the country, search for valuable minerals waxed and waned but never ceased. Discoveries of importance were made, their frequency increasing toward the end of the century as the country was opened up by railroads, and as hitherto remote regions became accessible. Interest in mining was still largely local and transitory, and there was no general realization of the country's mineral possibilities or of the important part these were to play in its future development. The famous rush of gold seekers from California to the newly discovered placers in the Fraser River, in British Columbia, which took place in 1858, was the beginning of metal mining in that province and Nova Scotia's long career as a gold producer began, amid much excitement, with the discovery of rich gold lodes there in 1862. The Chaudiere River placers, in Quebec, yielded about $2,000,000 in gold between 1860 and 1876, and a short-lived gold rush to central Ontario occurred in 1866.

For several years following 1853, copper was mined with indifferent success at Bruce mines, on the north shore of Lake Superior. In 1858, work was commenced on the Acton copper mine, in the eastern townships of Quebec, said to have been in its time the largest copper mine in the world and a source of phenomenal wealth during the period of high-priced copper caused by the American Civil War. Silver Islet on Thunder Bay, at the west end of Lake Superior, yielded over $3,000,000 in silver between 1870 and 1884; and commercial production from Quebec's now world-famous asbestos fields began in 1878-79. The building of the Canadian Pacific transcontinental railway, in the course of construction of which the Sudbury nickel-copper deposits were first uncovered in 1883, caused another wave of exploration and development. Following its completion, the discovery of gold in the Lake of the Woods district of western Ontario was followed in the nineties by a boom more remarkable for unbridled speculation and unscrupulous company promotion than for the tangible results obtained. However, about this same time, a series of important discoveries of silver, lead, copper, and gold that have since yielded immense wealth was being made in the Slocan, Rossland, and Boundary districts in British Columbia. Lode mining in British Columbia began in 1887 with the shipping of rich silver-lead ores from the Slocan. A smelter at Trail, the predecessor of the Consolidated Mining & Smelting Company's present gigantic plant, went into operation in 1895. The famous Klondike rush to the gold placers of Yukon in 1897-98 is an incident somewhat apart from the general trend of mining development in Canada, but much too important to be overlooked.

The beginning of the third and most noteworthy period in the history of Canadian mining is recorded statistically in the sharp rise in the annual value of the mineral output between 1896 and 1906:

The period as a whole is character-

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ized by a large number of widespread developments and discoveries, the importance of which has been greatly enhanced by contemporaneous advances in the arts of ore dressing and metallurgy. Though much of the foundation had been laid previously, it is chiefly to the rapid progress made since 1900 that mining owes its present status of one of the Dominion's greatest basic industries and that the Dominion owes its present high rank among the great mining countries of the world.

	Value of Annual Mineral Production	Value Per Capita
1886	$ 10,221,255	$ 2.23
1896	22,474,256	4.38
1906	79,286,697	12.81
1916	177,201,534	22.05
1926	240,437,123	25.99
1928	274,989,487	.....

As a result of the stimulus given to prospecting by the discovery of the tremendously rich silver deposits at Cobalt in 1903, came the discovery of the great gold camps at Porcupine, in 1909, and Kirkland Lake in 1912; of great bodies of zinc-copper ores in Manitoba, at Flin Flon, in 1915, and Sherritt Gordon in 1923; and in 1924 the rich copper-gold camp of Rouyn, in Quebec, that in its first year of production (1928) yielded over 33,000,000 lb. copper and more than $1,000,000 in gold. During this same time, British Columbia's three great copper mines were being developed and came into production—Britannia about 1905; Anyox in 1914; and Copper Mountain in 1925. The famous Premier mine, first discovered in 1910, yielded gold and silver worth about $29,000,000 between 1921 and 1927. Subsequent to 1916, the still more famous Sullivan was transformed by the development of selective flotation from an unimportant lead mine to perhaps the world's biggest lead-zinc producer. Last but not least was the unexpected but not chance discovery at depth on the Frood nickel-copper mine at Sudbury, in Ontario, first announced in 1925, which has been authoritatively described as probably the largest body of exceptionally high-grade ore yet found in the history of mining.

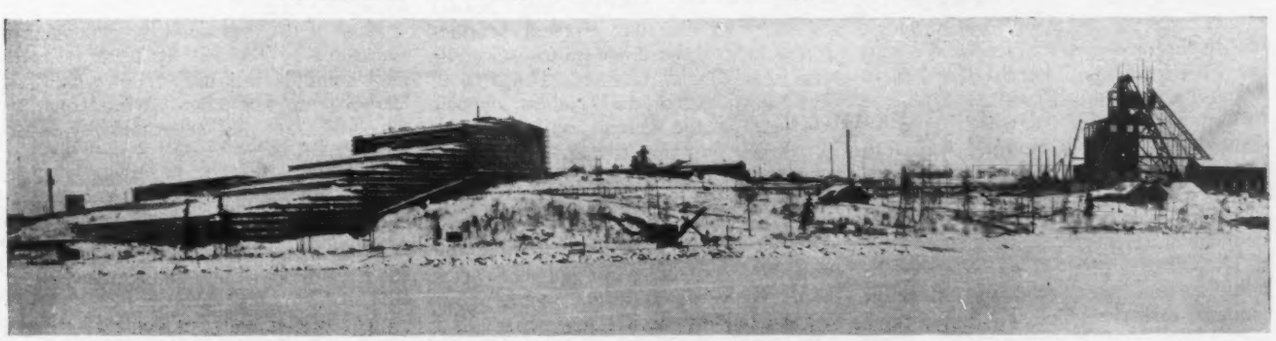
At the present time mining is third in importance among the country's basic industries, the net value of its annual output amounting to about 11 per cent of the total net annual value of primary production in the Dominion, as compared with about 66 per cent for agriculture and 15 per cent for forestry. This output includes nearly 70 mineral products; but 98 per cent of its value can be grouped under 18 headings, which, in the order of their monetary importance are: coal, gold, copper, nickel, cement, lead, silver, clay products, asbestos, stone, zinc, natural gas, sand and gravel, lime, gypsum, petroleum, cobalt, and salt, each of which is produced to a value of upwards of $1,000,000 annually. Several other products, such as feldspar, magnesite, pyrites, talc, mica, and graphite, have potential commercial value much in excess of that indicated by their present rate of production, which is limited by market conditions, not by lack of reserves from which to draw.

Metals still contribute slightly less than half the total value of Canada's mineral output, but the rate at which they are being produced is increasing rapidly; and it is to the rapid increase in its metal production during recent years—an increase that has been greatly aided by improvements in flotation processes of ore dressing and in electrometallurgy as well as by the almost universal availability of cheap hydro-electric power—that Canada is chiefly indebted for its prestige as a mining country. Over the five-year period from 1923 to 1928 production of zinc in Canada increased from 30,208 tons to 92,324, or 205.6 per cent; that of lead from 55,617 tons to 168,974 tons, or 203.8 per cent; copper, from 43,442 tons to 101,398 tons, or 133.4 per cent; nickel, from 31,227 tons to 48,388 tons, or 54.9 per cent; gold, from 1,233,341 oz. to 1,890,592 oz., or 53.3 per cent; and silver from 18,601,744 oz. to 21,936,407 oz., or 17.9 per cent. Present indications are that, with all these metals, production will go on increasing for at least several years. Especially large increases are to be looked for immediately in copper and nickel, and, farther in the future, probably in zinc. The other metals produced in Canada —such as bismuth, cadmium, cobalt, palladium, platinum, rhodium—are obtained as byproducts of the working of one or other of those previously mentioned, so that the rate at which they are produced depends in part on the price obtainable for them and in part on the rate of production of the predominant metal with which each happens to be associated.

Main five-compartment shaft at the Sherritt Gordon mine at Cold Lake, The Pas, Manitoba

Gold has been mined in Canada, with varying success, for nearly 80 years, and is now, next to coal, the chief mineral product of the Dominion, in point of value. Production is from three general types of deposit: (1) auriferous quartz lodes worked primarily for their gold content, of which Porcupine and Kirkland Lake are the outstanding examples; (2) auriferous base-metal deposits—chiefly those of copper, of which the gold content may or may not be essential to profitable working—like those

At Flin Flon—the new 3,000-ton concentrator as it appeared in November



at Rouyn in Quebec, at Britannia, Anyox, and Copper Mountain in British Columbia; and (3) from alluvial deposits in Yukon and British Columbia. Up till 1890 the bulk of the production was placer gold from British Columbia, and again, for some years following 1898, the Yukon placers were the principal source. At the present time, however, 85 per cent of the output is from the gold-quartz mines; base-metal mines of copper, lead, zinc, and nickel, furnish about 13 per cent; and placers only about 2 per cent of the total.

No material increase in the production of alluvial gold is to be expected, but increasing amounts of lode gold are likely to be won, especially when consideration is given to the rapid expansion of auriferous base-metal mining now definitely under way and the number of gold-quartz deposits being explored and developed.

A comparison of Canada's record as a gold producer with that of the three great gold-producing regions of modern times—the Transvaal, the United States, and Australasia—indicates that, in 1928, Canada produced 9.7 per cent of the world's gold, against 53.1 per cent for the Transvaal, 11.3 per cent for the United States, and 3 per cent for Australasia. Her maximum annual output, valued at $39,082,005 in 1928, is however less than one-fifth the Transvaal's maximum of over $214,000,000, in the same year, and well under one-half the United States' maximum of over $101,000,000 in 1915, or Australasia's of nearly $90,000,000 in 1903. Also, Canada's total recorded contribution to the world's stock of gold from 1858 to the end of 1928 is only about 1,152 tons, whereas the Transvaal, from 1884 to 1928, contributed 7,853 tons; the United States, from 1848 to 1928, 7,398 tons; and Australasia (Australia and New Zealand), from 1851 to 1928, 6,143 tons. Despite her present position as the world's third largest gold producer, Canada has still much ground to cover before she can be classified as one of the world's greatest gold producers.

Large and important *copper* mines are either in operation or being equipped for operation in four Canadian provinces. Present production is almost entirely from Britannia, Anyox, and Copper Mouutain, in British Columbia; from nickel-copper mines at Sudbury, in Ontario; and from Noranda in Quebec. Other mines of the first magnitude that will be operating within the next year or year and a half are Flin Flon and Sherritt Gordon, in Manitoba, and the Frood at Sudbury, in Ontario, all three of which have indicated ore reserves running well into the millions of tons. The next five years will probably see Canada's present annual copper production of 101,398 tons doubled or tripled.

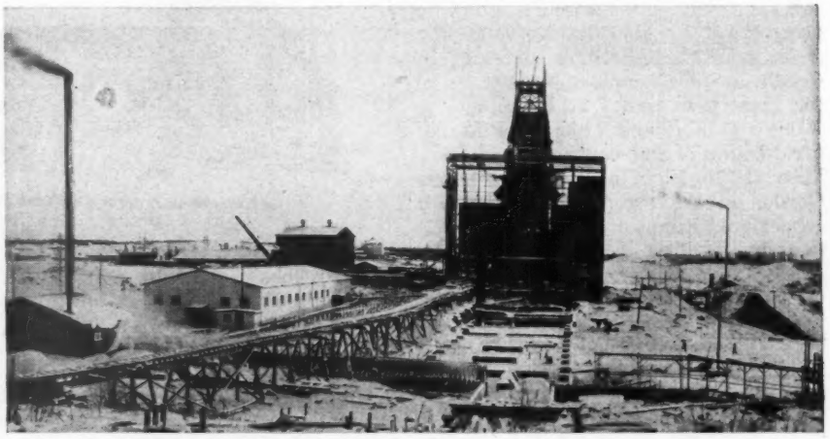
The ores in all these mines carry, in addition to copper, gold and silver in amounts at least sufficient to make their recovery as byproducts profitable, and in the ores of the Horne mine, at Noranda, a major source of profit. Sudbury mines are worked primarily as nickel mines, but the proportion of copper to nickel in the new Frood orebody is so high that its working, if considered alone, might be regarded as a great copper-mining operation. For the Flin Flon and Sherritt Gordon mines the recovery of both copper and zinc will probably be necessary for successful operation.

Almost all Canada's copper production up to the present has been shipped abroad in the form of blister copper, matte, and concentrates for final treatment. An electrolytic copper refinery capable of producing 120,000 tons of refined copper a year, however, is now being built at Sudbury and will probably be operating in 1930. The establishment of two others—one in eastern Canada, the other on the Pacific coast—is contemplated, so that in the near future most of Canada's copper will probably be marketed in refined form. For no metal produced in Canada is there a brighter outlook than for copper, with the possible exception of nickel.

With some minor exceptions all the *nickel* produced in Canada has come from the vicinity of Sudbury, Ontario, where it has been mined for the last 43 years. The working mines occur scattered around the outer edge of an elliptical area about 36 miles long and 16 miles wide in its widest part. All —with one exception, the Falconbridge mine now under development—are owned by the International Nickel Company of Canada. Present production is from three large mines—Creighton, Levack, and Garson. The Frood, much the largest and richest deposit yet found in the district, will not come into full production till 1930, when the independent mine, the Falconbridge, should also be producing.

The ores are a mixture of iron, copper, and nickel sulphides, in which the proportion of nickel to copper varies considerably in different mines; but may be put on the average at, say, 2.5 or 3.0 per cent nickel to 1.5 or 2.0 per cent copper. A marked exception to the general rule is the new Frood orebody in parts of which the copper runs as high as 20 per cent or more, though the nickel content remains at about the same average for the district. In addition to nickel and copper, the Sudbury ores carry minute quantities of palladium, platinum, rhodium, silver and gold, which, becoming concentrated in the nickel and copper in the course of the various processes through which these pass, are recovered in the final refining process and are a source of considerable additional profit. Practically all of Canada's production of *palladium, platinum* and *rhodium* is derived from this source.

Known reserves of workable nickel-copper ores in the Sudbury district run into the hundreds of millions of tons; and the possibility of further discoveries is by no means exhausted. From time to time in recent years new orebodies have been brought to light; others that were thought to be approaching exhaustion became more productive than ever, and much favorable ground remains to be explored. The expansion of the nickel-mining industry in Canada will, for many years, be limited only by the world's ability to absorb the output, and, everything considered—the immense reserves; the richness of the ores and the varied sources of profit they afford; the rate at which nickel is becoming a practically indispensable industrial metal; and the amplitude of opportunity for its further use—this expansion should be rapid.



Construction at Flin Flon—the new main shaft headframe

Most of the *lead* and *zinc* produced in Canada are obtained by treating complex sulphide mixtures from which the lead-bearing and zinc-bearing constituents are taken out separately by selective flotation processes; and 90 per cent of the output is marketed as electrolytically refined lead and zinc that has its chief source in the Consolidated Mining & Smelting Company of Canada's Sullivan mine, at Kimberley, in British Columbia—probably the world's largest known lead-zinc deposit—the ore

McIntyre Porcupine's mine and mill near Timmins, Ont.

from which together with that from other and smaller mines scattered over British Columbia is treated in the company's plant at Trail. In addition to the electrolytically refined lead and zinc produced at Trail, one small mine in Ontario makes between 3,000 and 4,000 tons of furnace-refined lead annually; and some lead is exported in argentiferous lead ores and concentrates from mines in Yukon, British Columbia, and Quebec. Zinc in concentrates is also exported to Europe, from mines in British Columbia and Quebec. Nova Scotia will probably be exporting lead, zinc and copper concentrates within a year from the time a mill is finished in the Stirling mine, in that province.

Further large increases in zinc output within the next few years are already in sight, from the Flin Flon and Sherritt Gordon mines in Manitoba, which will be producing shortly, and from zinc-lead-copper deposits now being developed near Sudbury, in Ontario. The Rouyn district, in Quebec, will probably, within a few years, be producing considerable zinc in addition to copper and gold. An electrolytic zinc reduction plant to treat the zinc concentrates that will be produced at Flin Flon is now being built at the mine, and plans for the establishment of another in eastern Canada to handle the product of eastern mines, may soon be announced.

With the gradual exhaustion of the Ontario silver-cobalt deposits, which reached their maximum production in 1911, and the rapid expansion of base-metal and gold mining, *silver* is now produced in Canada chiefly as a byproduct metal incidental to the working of lead, zinc, copper and gold ores. The Sullivan lead-zinc mine, in British Columbia, for example, is now the largest producer of silver in Canada, and the new Frood copper-nickel mine will probably also be an important silver producer. The trend of future production of silver in Canada will therefore follow closely the combined trend of base-metal and gold mining, unless and until new silver mines are found.

At present, the sole Canadian source of *cobalt* is Ontario's silver-cobalt ores, from which it is obtained chiefly as a byproduct, though some of these that are low in silver are now being mined primarily for the cobalt content. *Bismuth* also is a byproduct of Ontario's silver-cobalt ores, as well as of electrolytic lead refining at Trail, British Columbia. *Cadmium* and *antimonial lead* are other byproducts of British Columbia ores treated in the metallurgical plant at Trail. *Arsenic* is recovered in the form of white arsenic from silver-cobalt ores in Ontario and is also a valuable constituent of certain auriferous concentrates that are produced in British Columbia and sent to the United States for treatment.

Never in the history of the Dominion has so much active interest been shown in Canadian mining enterprises and mining possibilities as at present. Mines and minerals will certainly be important factors in the country's future development. They will play a far bigger part in its economic life than they do now or ever have done in the past.

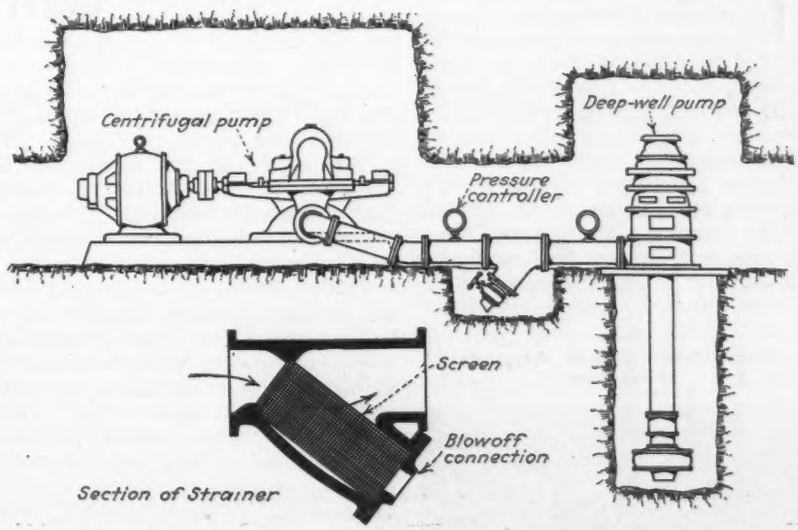
■ ■ ■

Strainer on Pump Suction Cuts Maintenance Costs

AN IMPORTANT consideration in underground pumping, to insure continuous operation at minimum maintenance cost, is to prevent foreign objects from entering the suction pipe of a pump, avoidable by the use of several screens and settling tanks, or an efficient strainer.

At the Silver King Coalition mine, at Park City, Utah, the underground pumping equipment, illustrated in the accompanying sketch, consists of a deep-well turbine pump direct-connected to the main-station centrifugal pump, supplying water to the latter under positive pressure. Both pumps are operated automatically, the deep-well pump through a device controlled by the rise and fall of the water level, and the centrifugal pump by a Teeple pressure controller.

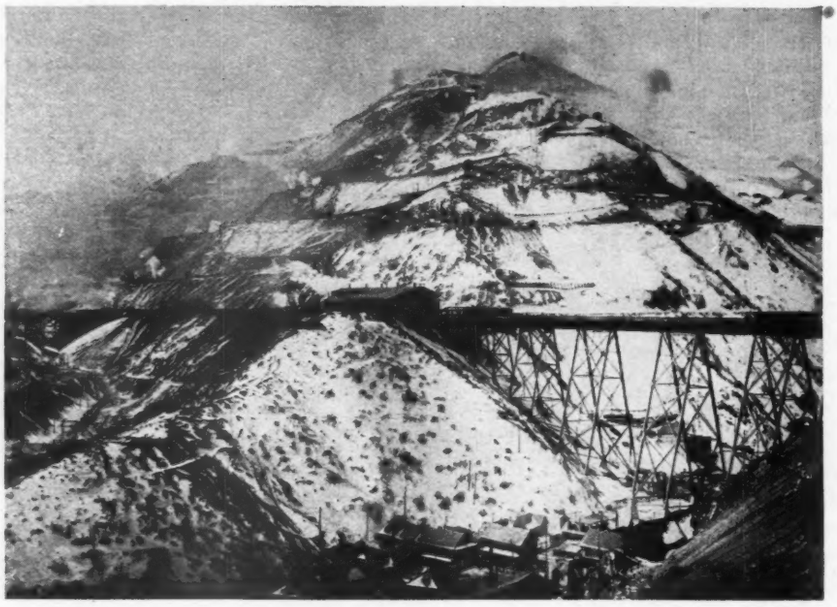
To protect the centrifugal pump from the entering foreign objects that may have passed the impeller of the deep-well pump, a Sarco strainer was installed on the suction pipe. This consists of a Y-shaped cast-iron body, with an inserted screen cylinder placed at such an angle as to offer the minimum obstruction to the flow of the water, at the same time to allow ample cleaning space. The blowoff connection, with its valve, permits the strainer to be cleaned instantly by merely opening the valve. Since the installation of this strainer, no shutdowns or replacement of new parts of the main station centrifugal pump have been necessary.



Electrified Haulage

Effects Important Economies

For Utah Copper



Utah Copper Company's mine at Bingham, Utah, prior to electrification

Gail Martin

Salt Lake City, Utah

THE year 1929 will be significant in the history of the Utah Copper Company for the setting of a new production record of about 305,000,000 lb. of copper, the disbursement of $32,489,000 in dividends, and completion of electrification of its mine.

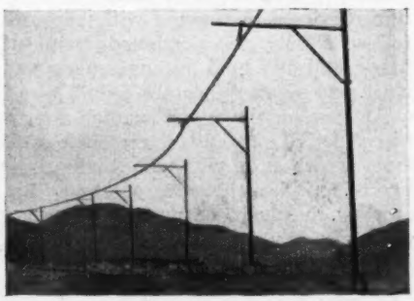
To what degree electrification aided production and profits no one can say, but the electrification of the shovels and the haulage system at the Bingham mine permitted marked economies that demonstrated conclusively the superiority of this type of installation and aided the company to surpass two previous high marks.

Electric locomotives in the yards at Bingham

The extent of rail operations at Bingham and its influence on mining have combined to make the advantages of electrification more far-reaching than was expected.

One of the major benefits has been an increased haulage capacity at a lower cost. The most economical operation for steam power was reached at Bingham when eight cars per train were operated in mine service. With electrification, the number of cars was increased to ten, and frequently as high as twelve, and the speed raised 25 per cent. This simplified the traffic problem. Operation of heavier trains means fewer trains on the hill, fewer locomotives per shovel, and less delay per trip. Longer trains can be hauled to the shovels. This gives the locomotive more time to make a round trip and reduces delays in shovel operations. Before electrification, shovels in ore worked at 60 per cent capacity; shovels in waste at plus 45 per cent capacity. Part of this lost time was caused when the shovel had to wait for a train. To secure a 5 per cent gain in shovel output, it was estimated that there should be 25 per cent fewer placements. Hence, the same mine output is ob-

Movable side-arm trolley line used by Utah Copper



Waste dumps along the extensions of the benches at the Bingham mine

tained by the more frequent operation of fewer trains at lower cost.

Formerly, coal trains had to be operated to refuel steam locomotives on the upper levels. These have been eliminated, traffic congestion has thereby been reduced, and costs have been decreased. The increase of track capacity has diminished the need for additional track, which is far more expensive than is overhead trolley. Grades of switchback tracks built in the future can be increased where the contour is difficult, or where space for tracks is limited. The saving in this direction more than offsets the cost of extending electrification.

ONE of the objections to heavy grades for steam operation is the liability of uncovering the crown sheets when locomotives are backing up-grade. With a 20-ft. boiler, the variation in height of water in the gage glass between pulling and backing up a 4 per cent grade may be 16 to 19 in. This condition is still further accentuated with longer boilers and steeper grades. No such condition exists with electric locomotives. Furthermore, where the operation of double-unit locomotives would be of advantage, such as between Apex Yard and Bingham, two electric locomotive units can be operated by one crew. No such flexibility is possible with steam locomotives. The civil engineer, in laying out mine developments, is obliged to work within limits for steam operation which are narrower than those required for electric operation.

Trolley construction on the main benches and dump lines appeared to be objectionable, in that it may be put out of commission by blasting operations and also because the poles supporting the trolley have to be moved when the tracks are changed. These objections were overcome in the design of trolley construction and by frequent sectionalization. The subject has been given considerable study from the standpoint of design, to obtain a type which will permit locating the trolley 10 to 12 ft. off the center of the track, where it will not interfere with the operation of the shovels. With the use of extra-long adjustable brackets, it is possible to cover a wide strip before the poles supporting the wire will have to be moved to new locations. It has been found feasible to work a cable reel on the locomotive, in conjunction with this arrangement on the dump lines and on the main benches, to cover still greater areas without moving poles.

As an alternative and auxiliary to the all-trolley construction, several electric locomotives operate from an overhead trolley on the switchback tracks. These are equipped with a storage battery suppling power on part of the main benches and waste lines. The batteries will save 15 miles of trolley line on the benches, and likewise its maintenance, which has been estimated at $500 per mile per year. The difference in cost between the combination trolley and battery locomotive and the straight trolley locomotive has been taken at $10,000 per locomotive, which covers the cost of battery and charging equipment.

Maintenance and replacement of the battery has been taken at $10,000 over a period of four years, or $2,500 per locomotive per year. In addition, the combination trolley and battery locomotive has been charged with the power losses in the battery. The efficiency from the incoming line, where the power is purchased to the point where the output of the battery is measured, will be about fifty per cent. Assuming the battery will deliver 156 kw.-hr. per charge, it is necessary to estimate on 156 kw.-hr. losses per charge. In four years the losses per locomotive will amount to 156,000 kw.-hr., or 39,000 kw.-hr. per year. At 75c. per kilowatt-hour this amounts to $292 per locomotive per year. On this basis the maximum yearly charge for the 43 locomotives would be $12,556 for power, in excess of that required for straight trolley locomotives. This sum has been scaled down to $10,000 per year, based on limiting the service the battery will be called upon to perform when handling an average of 32,000 tons per day.

It will also be necessary to include

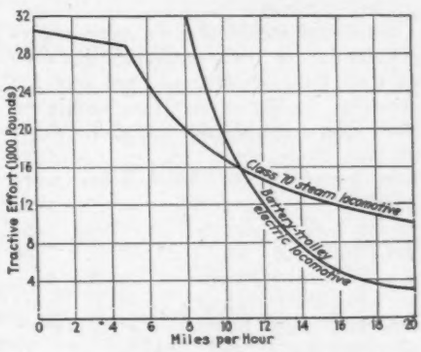


Fig. 1—Typical characteristic curves for steam and electric locomotives

the wages of battery watchmen, whose duties are to inspect the charging of locomotives to see that charging equipment operates properly and that the correct specific gravity of the battery is maintained, and to keep records of the amount of charge and condition of the equipment. The wages of these men has been estimated at a total of $14,000 per year.

Using these assumptions, and considering the ore and waste service together, the storage-battery equipment will show about the excess investment and operating costs over the straight

Investment

Difference in cost 43 locomotives at $10,000 each	$430,000
Credit cost of 15 miles trolley construction	75,000
Total excess investment	$355,000

Operation

Cost of upkeep and renewal, 43 batteries at $2,500 per year	$107,500
Cost of power loss in battery of 43 locomotives	10,000
Wages of battery watchmen	14,000
Credit up-keep on 15 miles of trolley $500 per mile	7,500
Total excess operating expenses	$124,000

Bench Levels	APEX YARD	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
APEX YARD		65	186	241	306	371	430	484	541	602	655	706	755	816	877	930	997	1065
F	55		121	176	241	306	365	419	476	537	590	641	690	751	812	865	932	1000
G	152	97		55	120	185	244	298	355	416	469	520	569	630	691	744	811	879
H	201	146	49		65	130	189	243	300	361	414	465	514	575	636	689	756	824
I	249	194	97	48		65	124	178	235	296	349	400	449	510	571	624	691	759
J	301	246	149	100	52													
K	349	294	197	148	100													
L	398	343	246	197	149				57	118	171	222	271	332	393	446	513	581
M	446	391	294	245	197			48										
N	493	438	341	292	244			95			53	104	153	214	275	328	395	463
O	530	475	378	329	281			132		37		51	100	161	222	275	342	410
P	568	513	416	367	319			170		75	38		49	110	171	224	291	359
Q	606	551	454	405	357			208		113	76	38		61	122	175	242	310
R	655	600	503	454	406			257		162	125	87	49		61	114	181	249
S	704	649	552	503	455			306		211	174	136	98	49		53	120	188
T	745	690	593	544	496			347		252	215	177	139	90	41		67	135
U	800	745	648	599	551			402		307	270	232	194	145	96	55		68
V	858	803	706	657	609			460		365	328	290	252	203	154	113	58	

Upgrade / Downgrade

Fig. 2—Chart showing net kilowatt-hours of work done per 1,000 tons moved upgrade and downgrade

trolley locomotives, based upon handling an average of 32,000 tons per day, indicated in the table at the bottom of the preceding page.

Based on facts taken from an analysis similar to the foregoing, the type of electric locomotive adopted was for straight trolley operation, equipped with side-arm trolleys or cable reels as may be required. A few combination battery-trolley locomotives were purchased for general utility service, to be used where the overhead construction was not economical. The storage-battery equipment for this type of locomotive consists of 120 Exide Ironclad cells, having a capacity of 680 amp.-hr. at 230 volts.

Facilities for charging the battery from the trolley, consisting of a motor-generator set and battery charging panel, are provided for each locomotive and located in one end. Fig. 1 shows the characteristic curve of this locomotive when working from the trolley, as compared with the characteristic curve of the Class 70 steam locomotives now in service. When working on the battery the speed is about one-third of the speed on the trolley for the same tractive effort. This ratio of speed fulfills the requirements of slow-speed running, limited by the condition of the tracks across the benches.

The speed downgrade with loaded trains has been taken as the same for both steam and electric operation; but on upgrades, with eight and twelve cars respectively, the running time for electric trains will be 20 per cent faster than for steam, taking into account the longer distance the electric locomotives will travel. Assuming the road time for a round trip from the shovel back to the shovel is four times the running time upgrade, the saving in road time of electric over steam will be 5 per cent. Assuming that the electric trains will be 25 per cent heavier than the steam trains, the number of the former for a given tonnage will be only 80 per cent of the number of the latter. Deducting delays for refueling and for water, also time for hauling coal, the saving in crew time—electric over steam—will amount to about 30 per cent of the steam crew time. This estimate is considered conservative, because the electric locomotive may be hauling more than 25 per cent heavier trains if required, and no credit has been taken for fewer delays brought about by the operation of fewer trains.

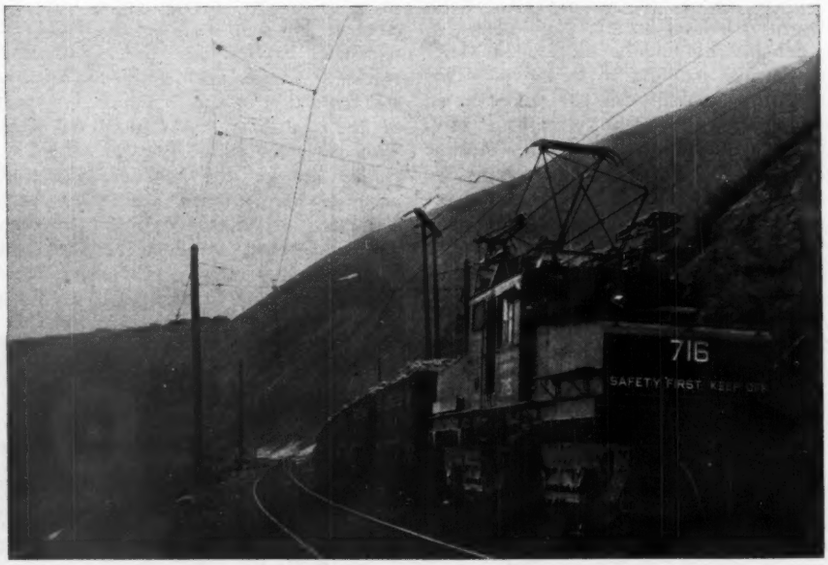
Furthermore, the electric locomotive makes it possible to operate with less spare equipment. The availability of electric shovels is greater than for steam shovels. Consequently, care has been taken to allow margin enough in the number of locomotives to permit taking advantage of this fact. That is, on account of the fact that electric shovels may be worked over longer periods between overhauling, a greater

Table I—Estimated Energy Consumption; Waste-haulage Service

	Steam	Electric
Number of cars loaded	210,170	210,170
Number of cars per train	4	5
Number of trips	52,543	42,034
Weight of locomotive, tons	75	75
Weight of empty cars, tons	32	32
Tons moved, empty cars	6,725,440	6,725,440
Tons moved, locomotives	3,940,725	3,152,550
Total empty movement, tons	10,666,165	9,877,990
Weight of loaded cars, tons	94	94
Tons moved, loaded cars, tons	19,755,980	19,755,980
Tons moved, locomotives	3,940,725	3,152,550
Total loaded movement, tons	23,696,705	22,908,530
Average distance hauled, miles	1.5	1.5
Net kilowatt-hours per 1,000 tons, empty	60	60
Net kilowatt-hours per 1,000 tons, loaded	45	45
Work done in net kilowatt-hours, empty movement	639,970	592,679
Work done in net kilowatt-hours, loaded movement	1,066,352	1,030,884
Work done in kilowatt-hours, spotting and stand-by losses		367,297
Total net kilowatt-hours		1,990,860
Equivalent tons of coal at 17 lb. per kilowatt-hour	14,504	.....
Spotting and stand-by losses (66.5 per cent)	9,657	.....
Total coal consumed, tons	24,151	.....
Efficiency, per cent		60
Total kilowatt-hours purchased		3,318,100
*Add for battery operation, kilowatt-hours		600,000

*Note: The kilowatt-hours added for battery operation is equivalent to about 0.5 mile, haul in each direction on the battery.

Electric locomotive, with pantograph and side arm trolley, coupled to ore train at Bingham



number may be operating at one time. Hence, a surplus of locomotives is provided.

Fig. 2 gives estimates of the work done in moving 1,000 tons, including locomotives, from any level on the switchback tracks to any other level. This chart also shows the work dissipated in the brake shoes and wheels

Table II—Typical Comparative Operating Expense; Ore-haulage Service

Expense item	Steam	Electric
Operating crew	$210,045	$145,490
Fuel	167,885	.....
Power	.....	36,206
Repairs and maintenance	215,760	59,442
Water	58,169	.....
Lubricants	8,034	2,195
Totals	659,893	243,333

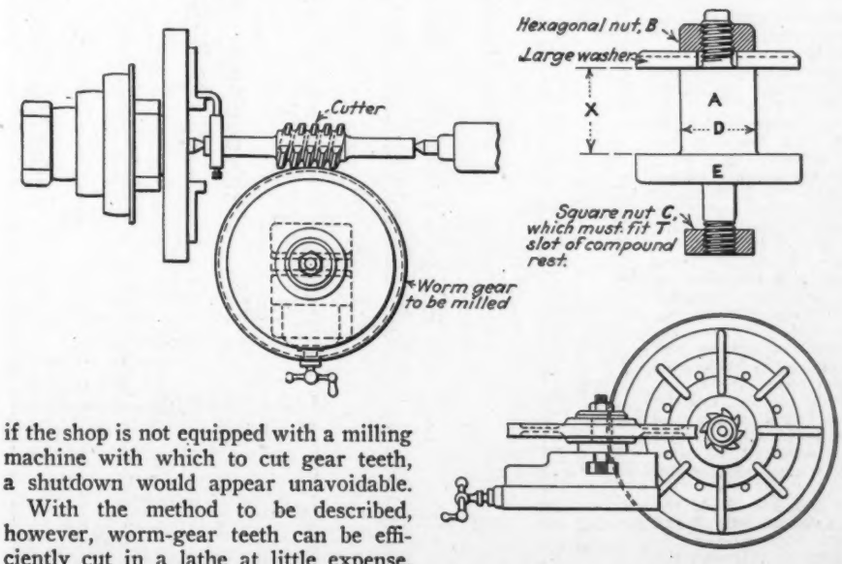
when holding back 1,000 tons, including locomotives, between any two levels on the switchback tracks. In addition to the work done on the switchback tracks, shown by the chart, it is assumed that each train will move an average of one-half mile on the level with an empty train, and back one-half mile with a loaded train in the ore service. The work done in moving an empty train on the level has been taken as 40 watt-hours per ton mile, or 20 kw.-hr. per 1,000 tons moved one-half mile. The work done in moving a loaded train on the level has been taken as 30 watt-hours per ton mile, or 15 kw.-hr. per 1,000 tons moved one-half mile.

Tables I and II show the application of the above factors, as well as the values taken from the chart in Fig. 2, to arrive at the work done in handling the tonnage estimated for twelve months. In steam-locomotive operation it has been necessary to convert the work done into pounds of coal and the following factors have been used: Pounds of coal per kilowatt-hour on switchback tracks, 12; pounds of coal per kilowatt-hour on benches, 17; pounds of coal per kilowatt-hour on locomotive-hour spotting and stand-by losses, 200-300.

The coal burned while on switchback tracks includes that used in doing useful work plus that burned during delays. That burned while moving across the benches is higher for the work done than that done on the switchback tracks, owing to the fact that on the benches it is necessary to operate with the throttle partly closed and at an uneconomical cutoff. The amount of fuel consumed while spotting trains, standing idle, and running downgrade amounts to nearly 40 per cent of the total burned. If this is distributed over a period of eight to twelve hours, when the fires are banked or the drafts checked, the average consumption amounts to 200 to 300 lb. of coal per engine per hour. The same procedure has been followed in estimating the energy consumption for electric locomotives. An efficiency of 60 per cent has been assumed to arrive at the kilowatt-hours purchased per year, and 25 per cent has been added to cover stand-by losses and errors in assumptions. Estimates of the fuel and energy consumption in waste service have been made on the basis of a level haul averaging one and one-half miles each for empty and loaded trains. These assumptions seem to be in line with those made for the ore haul.

Cutting Worm-Gear Teeth in a Lathe

SMALL worm gears used in continuous-operation equipment such as zinc dust feeders, automatic samplers, and scales are likely to wear rapidly. Spare gears may not be ordered in time, and if the shop is not equipped with a milling machine with which to cut gear teeth, a shutdown would appear unavoidable.



With the method to be described, however, worm-gear teeth can be efficiently cut in a lathe at little expense. Only two parts are required—pivot pin *A*, and a carefully machined and tempered milling cutter of tool steel and of the exact shape of the worm. Pin *A* is made of mild steel, consisting of one hexagonal nut *B*, a large washer, and a square nut *C*, which fits into the "T" slot of the compound rest of the lathe.

The operation is simple. Bolt pin *A* tightly to the compound rest after its threaded stud end with nut *C* has been inserted in the T-slot. Now place the worm gear blank on pin *A*, its flange ring *E* offering sufficient bearing surface. Bolt the washer down tightly with nut *B*. Diameter *D* being $\frac{1}{16}$ in. smaller than the bore of the blank, and dimension *X* being $\frac{1}{16}$ in. larger than the thickness of the hub, the gear blank can be revolved without difficulty. Place the cutter, with the bent tail dog clamped on, between the live and dead center of the lathe. Run the lathe at slow speed, and move the compound rest with the gear blank slowly toward the cutter, the spiral motion of which will revolve the gear blank. At the same time gradually cut the exact number of teeth in accordance with the calculated outside diameter of the blank. Smooth operation from the start can be effected by first filing out two teeth by hand to a depth of $\frac{1}{16}$ in., thus offering a guide to the cutter. By using sufficient lubrication a perfect cut gear will result.

■

The Motor Starter and Its Function

IF AN idle direct-current motor is subjected to full-line voltage, it will absorb an excessive amount of current, involving the danger of overheating and burning. For this reason a device should be used to protect the armature windings, by regulating the inflow of current during the motor's acceleration to full speed and while the counter voltage is building up. The starter does not, as some believe, regulate the speed of a direct-current motor.

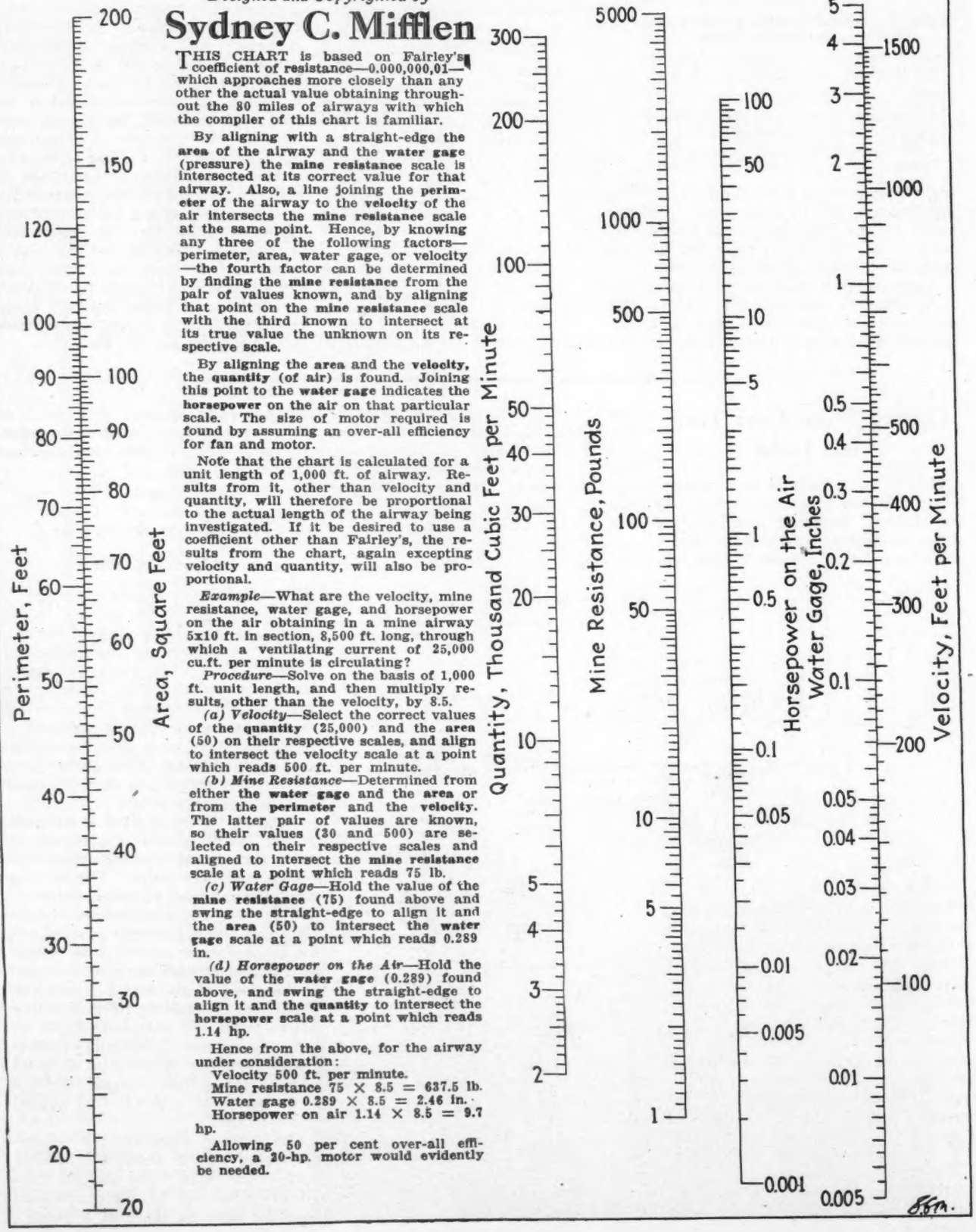
A motor starter in itself is a simple device, but it should be designed to meet the varied starting conditions encountered in practice. The starting work of a fan used for mine ventilation is light, involving a small motor torque. Only by a gradual increase of speed will the air resistance on the rotor blades become greater, until the constant speed or full load of the motor is reached. Conditions are entirely different with a water pump of the centrifugal or reciprocating type, the amount of power needed depending on the head of water lifted. Heavy back pressure develops on the pump valves if it is not equipped with a bypass.

The starting conditions for the reciprocating type of pump will be even more severe than those for the centrifugal pump; of an air compressor, almost the same as those of a pump.

Mine Ventilation Chart

Designed and Copyrighted by

Sydney C. Mifflen



THIS CHART is based on Fairley's coefficient of resistance—0.000,000,01—which approaches more closely than any other the actual value obtaining throughout the 80 miles of airways with which the compiler of this chart is familiar.

By aligning with a straight-edge the **area** of the airway and the **water gage** (pressure) the **mine resistance** scale is intersected at its correct value for that airway. Also, a line joining the **perimeter** of the airway to the **velocity** of the air intersects the **mine resistance** scale at the same point. Hence, by knowing any three of the following factors—perimeter, area, water gage, or velocity—the fourth factor can be determined by finding the **mine resistance** from the pair of values known, and by aligning that point on the **mine resistance** scale with the third known to intersect at its true value the unknown on its respective **scale.**

By aligning the **area** and the **velocity,** the **quantity** (of air) is found. Joining this point to the **water gage** indicates the **horsepower** on the air on that particular scale. The size of motor required is found by assuming an over-all efficiency for fan and motor.

Note that the chart is calculated for a unit length of 1,000 ft. of airway. Results from it, other than velocity and quantity, will therefore be proportional to the actual length of the airway being investigated. If it be desired to use a coefficient other than Fairley's, the results from the chart, again excepting velocity and quantity, will also be proportional.

Example—What are the velocity, mine resistance, water gage, and horsepower on the air obtaining in a mine airway 5x10 ft. in section, 8,500 ft. long, through which a ventilating current of 25,000 cu.ft. per minute is circulating?

Procedure—Solve on the basis of 1,000 ft. unit length, and then multiply results, other than the velocity, by 8.5.

(a) Velocity—Select the correct values of the **quantity** (25,000) and the **area** (50) on their respective scales, and align to intersect the velocity scale at a point which reads 500 ft. per minute.

(b) Mine Resistance—Determined from either the **water gage** and the **area** or from the **perimeter** and the **velocity.** The latter pair of values are known, so their values (30 and 500) are selected on their respective scales and aligned to intersect the **mine resistance** scale at a point which reads 75 lb.

(c) Water Gage—Hold the value of the **mine resistance** (75) found above and swing the straight-edge to align it and the **area** (50) to intersect the **water gage** scale at a point which reads 0.289 in.

(d) Horsepower on the Air—Hold the value of the **water gage** (0.289) found above, and swing the straight-edge to align it and the **quantity** to intersect the **horsepower** scale at a point which reads 1.14 hp.

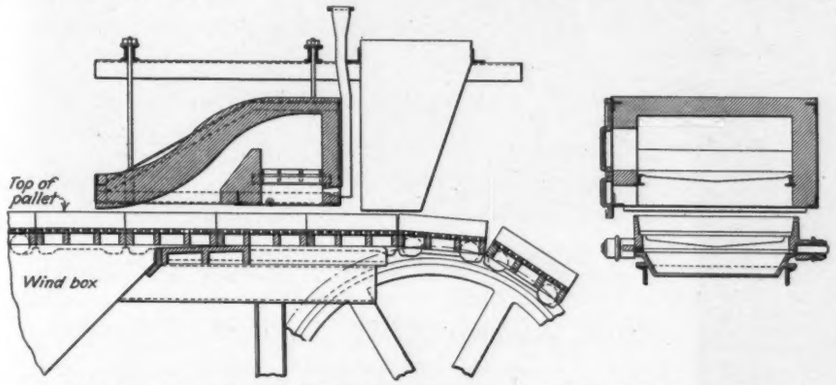
Hence from the above, for the airway under consideration:

Velocity 500 ft. per minute.
Mine resistance 75 × 8.5 = 637.5 lb.
Water gage 0.289 × 8.5 = 2.46 in.
Horsepower on air 1.14 × 8.5 = 9.7 hp.

Allowing 50 per cent over-all efficiency, a 20-hp. motor would evidently be needed.

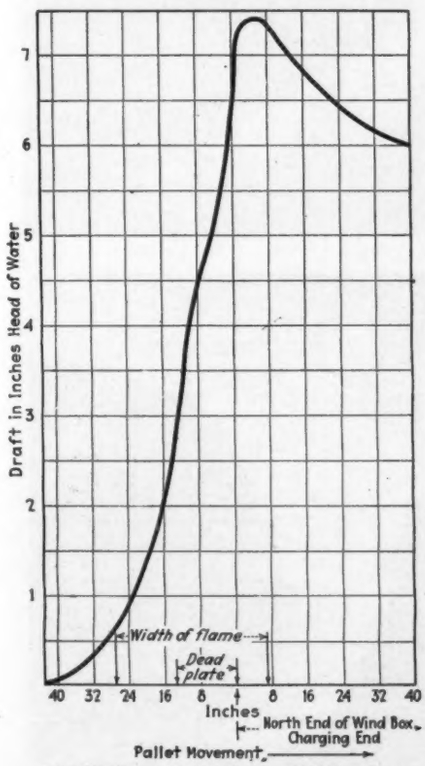
Sintering Machine Igniter Perfected at Bunker Hill Smelter

THE Bunker Hill Smelter has developed an improved type of ignition muffle for the Dwight-Lloyd sintering machines, on which improvement has long been needed, especially in plants where a charge high in lead is roasted, writes A. F. Beasley, superintendent. This new type of igniter insures better ignition and a more uniform and better product than has been possible previously on any type of muffle known to the art. It will be known as the Beasley combustion igniter. Solid or liquid fuels may be used with this igniter, which is illustrated herewith.

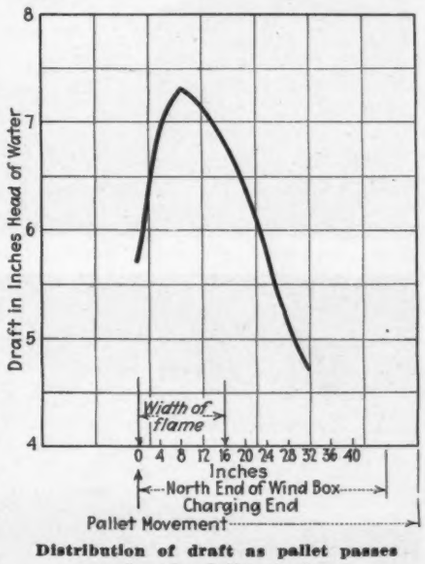


Sectional drawings showing design of Beasley combustion igniter for sintering machine fired with solid fuel

As will be seen, the dead plate at the charging end of the machine is tilted slightly downward and forward toward the wind box, to allow a small amount of leakage therefrom. Naturally, the draft back of the wind box through the charge diminishes as the distance increases from the wind box. The length of the new igniter is much greater than anything of like character heretofore used. The flame and products of combustion are made to travel both downwardly and forwardly, parallel with the direction of the pallet travel, rather than being laterally confined across the ore bed within narrow limits, as in all other previous methods of ignition.



Distribution of draft as pallet passes under the Beasley igniter



Distribution of draft as pallet passes under the Salida igniter

At the Bunker Hill Smelter this igniter has been found to be especially adapted for ores containing a low percentage of sulphur and a high percentage of lead. In continuous use, it gives better results than with any other type of igniter.

The initial ignition takes place where the suction through the ore charge is only slightly above zero pressure, and where the flame and heat of the products of combustion are at their greatest distance upwardly from the ore bed, and, consequently, at the coolest point in the muffle. As the pallet moves forward in its path, suction gradually increases until the pallet passes over the wind box. During the pallet's forward movement, heat gradually increases, aided by the downward and forward sloping arch roof or flame retainer of the igniter. Note that the arch almost flattens out, so that it is just above the ore bed when it reaches the wind box.

With the Beasley combustion igniter the ore is ignited with the least amount of heat and suction, gradually increasing both until the pallet reaches the wind box, where the greatest amount of suction occurs and the arch is at its lowest point, thus giving the most intense heat. The sulphur is not merely kindled, as in other igniters, but ignition is advanced both in length and breadth of the orebody, and also in depth, so that ignition in this device amounts to a well-advanced combustion before the ore reaches or is subject to the full action of the wind box. Thus is prevented the fusing of the top of the ore charge, which so often forms a seal, preventing the free passage of air and good roasting, a condition which occurs frequently when the charge is ignited initially over the wind box, with a maximum amount of suction and intense heat over a narrow width.

The accompanying graphs show the suction in inches of water in the pallet travel through the Beasley combustion igniter and also through the Salida type of burner heretofore used at the Bunker Hill plant. These graphs readily show the advantages to be derived in igniting a charge both low in sulphur and high in lead with the Beasley igniter.

Estimation of Low Acid Content

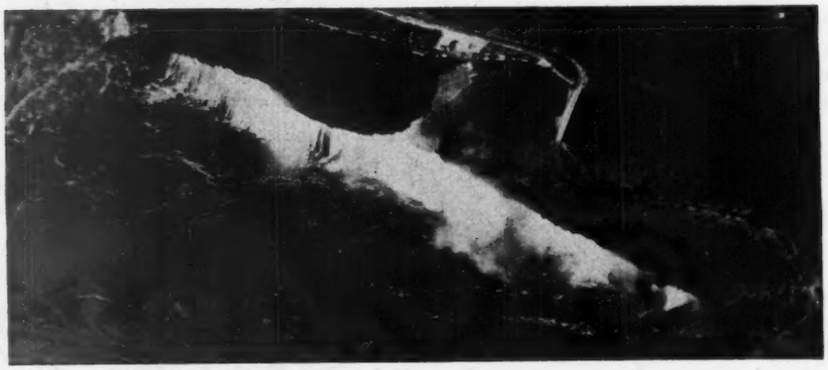
A RAPID METHOD of estimating small amounts of free acid in solutions or pulps, where a high degree of accuracy is not essential, follows. A box 20 in. square and 4 in. high is filled with limerock, ground to about 80 mesh. The limerock is spread evenly, and several circular impressions, about 2 in. in diameter and ½ in. in deep, are made in it with a round smooth object. The sample to be tested is poured into one of the depressions. Free acid reacting with the limerock liberates carbon dioxide gas, which rises to the surface of the solution. The operator will soon be able to estimate the acid content from the intensity of this gas evolution.

The estimate, taking only a few seconds, is of great value if many samples must be tested to check the various steps in a leaching operation.

AFRICA —A Land of Opportunity

Members of Constituent Societies attending Forthcoming Mining & Metallurgical Congress will Visit all Points of Technical and Scenic Interest, including the Victoria Falls, Zambesi River, Pictured Herewith

Airplane views by Aircraft Operating Company, Ltd.



THE Third (Triennial) Empire Mining and Metallurgical Congress will be held in South Africa from March 24 to May 9, 1930, beginning and ending at Cape Town. During that time two simultaneous tours in special trains will be made of the Union of South Africa, Southern and Northern Rhodesia. Those taking Tour No. 1 will visit the principal mining centers and other places of interest in the Union and in Southern Rhodesia, and also proceed to Northern Rhodesia as far north as B'wana M'Kubwa. Those taking Tour No. 2 will travel as far north as the Victoria Falls with the members of Tour No. 1; but, while the latter are in Northern Rhodesia, they will visit the principal centers in Southern Rhodesia, and the Zimbabwe Ruins.

Meetings and technical sessions will be held in the following centers: Cape Town, March 26; Kimberley, March 29; Johannesburg, March 31, April 3 and 7; Bulawayo, April 9; Durban, May 2.

Ten constituent institutions compose the congress, as follows:

Australasian Institute of Mining and Metallurgy.

Canadian Institute of Mining and Metallurgy.

Chemical, Metallurgical and Mining Society of South Africa.

Institute of Metals.

Institution of Mining and Metallurgy.

Institution of Mining Engineers.

Institution of Petroleum Geologists.

Iron and Steel Institute.

Mining and Geologic Institute of India.

South African Institute of Engineers.

The organizing bodies for the congress are: the Chemical, Metallurgical and Mining Society of South Africa and the South African Institute of Engineers.

The congress is convened by the Empire Council of Mining and Metallurgical Institutions, the principal functions of which may be summarized as follows:

1. To serve as an organ of intercommunication and co-operation between the constituent bodies, and for the promotion and protection of their common interests.

2. To foster and maintain throughout the British Empire a high level of technical efficiency and professional status.

3. To convene successive congresses within the British Empire.

The congress has for its chief objects the discussion of papers dealing with the scientific, technical, and economic problems connected with the development of the mineral resources of the British Empire, and the mining and metallurgical industries.

Arrangements have been made with the Union Castle Steamship Company, the British India Line, the Aberdeen, Blue Funnel and White Star Lines, and the Deutsche Ost Afrika Line to grant a concession of 20 per cent on ordinary fares to members of the constituent societies and their families attending the congress. Those who intend to sail from England are reminded that the opening date in Cape Town, March 24, 1930, synchronizes with the arrival of the weekly mailboat due to sail from Southampton on March 7. Congress headquarters are at 100 Fox St., Johannesburg, South Africa. A booklet containing useful information is available.

Novel Change Obviates Compressed Air Shortage

MANY PLANTS find upon expansion that their compressed-air supply is inadequate and that there is a demand for additional compressors, writes F. M. Ahr in *Chemical & Metallurgical Engineering*. Often the purchase of greater compressor capacity can be avoided by a careful survey of all departments of the plant, determining the consumption with a view to conservation. Compressed air is easily wasted, and unconsciously too, so that very close scrutiny is necessary to maintain pressures. Even then, in spite of all economies, the demand for air may run close to the limit of capacity and the purchase of additional compressors become apparently unavoidable.

Such a condition arose in a plant having three Ingersoll-Rand compound compressors running at 175 r.p.m. and maintaining 100-lb. pressure. Just about the time it was decided to purchase another cross-compound compressor, a survey was suggested as to the pressures required around the plant. About 75 per cent of the air used required less than 30-lb. pressure.

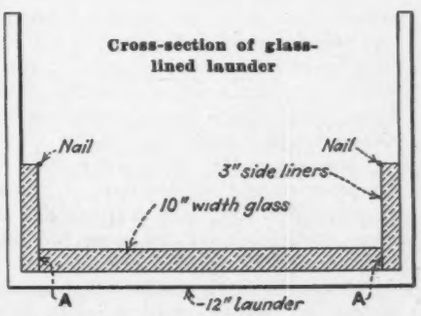
The low-pressure cylinder could maintain a 30-lb. pressure alone, without the use of the second stage of compression. After consulting the manufacturers the high-pressure cylinder was changed to the same size and type as the low-pressure cylinder, and the two cylinders were operated individually, both taking air from the atmosphere and discharging into the same low-pressure receiver. This doubled the capacity of the compressor. The change was made on two of the compressors, with the necessary changes in piping and receiver tanks. The remaining high-pressure compressor was connected into a separate tank and lines to it were reconnected.

We had no further trouble, Mr. Ahr concludes, with air shortage and really obtained much better operating conditions than before on the processes requiring lower-pressure air, because we avoided the use of throttling valves and pressure reducers.

■

Glass for Launder Lining

GLASS liners for launders have been used in some of the mills of the Century Zinc Company, of Kansas, for three years, writes C. O. Anderson, metallurgist. All table and flotation plant launders are now thus equipped. No lining has been replaced so far. The coefficient of friction of glass is less than that of cast iron. Launder grade may therefore be less if glass be used, and head room saved. A saving is made in expense, also, the cost per foot for glass being about half that of cast iron. The launder lining used by the Century company, of hammered rough glass, is purchased from the H. M. Hooker Glass & Paint Company, of Chicago, and costs 25.2c. per square foot, plus 6.6c. freight, or a total of 31.8c. It is bought in 3-ft. lengths, and in widths of 3, 4, 6, 8, and 10 in.



For example, a 12-in. spout is lined as follows (see sketch herewith): A 10-in. width is used and the bottom, and 3-in. widths, on edge, are used for the sides. The side liners are fastened with an occasional nail. Bottom and side liners are set in a thin slurry of quick-setting cement, compensating for a loose fit at *A*.

COMMENT AND CRITICISM

Defining Preliminary Impoverishment

To the Editor of "E.&M.J.":

Replying to Mr. E. G. Howe's letter in your issue of Dec. 14, I note that he minimizes my objection to the operation of two cyanide plants involved in Mr. Butters' flow sheet for the San Albino mine by suggesting that the plant for the cyanidation of the roasted concentrate would consist merely of a few 55-gal. drums. In so doing he makes some questionable assumptions: (1) that the ratio of concentration will be 100:1, whereas Mr. Butters states that it will be nearer 100:3; (2) that the product in question can be treated by percolation. Though Mr. Butters' communication gives no information on this point, I should consider it doubtful, since he states elsewhere that, before flotation, the entire ore is to be ground to 90 per cent minus-200 mesh. I admit that roasting tends to make a finely ground pulp more percolable, but nevertheless it seems to me that this would be a case for agitation; (3) Mr. Howe seems to take for granted that the cyanide plant for the concentrate is to consist only of lixiviation vats, the solutions therefrom presumably being added to those from the tailing plant for precipitation and subsequent disposal. This of course could be done, but it would prevent any actual check-up of the bullion from the two departments individually and the keeping of an accurate analysis of their respective efficiencies of operation, provision for which most metallurgists would consider desirable.

Referring to Mr. Howe's definition of "impoverishment": The term, I think, as originally used, was not intended to apply to the removal by some preliminary process of material refractory to a secondary or final process: that would be to inject into the word an implication it does not of itself possess. But, apart from that, the definition as it stands would hardly cover effectively the important case of the amalgamation of a gold ore prior to the cyanidation of the tailing.

Lest my criticism should be designated destructive rather than constructive, I have tried to find a better definition. My first attempt, suggested by the Editor's original remarks which started this discussion, was somewhat as follows, "In the case of an ore destined eventually to be beneficiated by a lixiviation process, the preliminary removal therefrom, by some mechanical or physical means, of as much of its valuable content as may be commercially feasible, with the object of diminishing the amount of the said valuable content before submitting the ore to lixiviation."

This of course would limit the reference to lixiviation processes. It afterward occurred to me that at least one important contingency would not thereby be covered—that of a gold ore which would yield a worth-while proportion of its gold by amalgamation, but which needed concentration to complete its beneficiation, leaving a tailing too low to be worth cyaniding. In such circumstances the question would arise whether it might not be good metallurgy to "impoverish" the ore by amalgamation before concentrating, even if concentration of the original ore should show as high an extraction as the combined processes. I therefore tried another definition which seemed more comprehensive.

"In a case where a method of beneficiation, *a*, can be applied for the extraction of a part of the valuable content of an ore, but is not capable of extracting as much of the valuable content that is commercially recoverable as is a method, *b*, 'preliminary impoverishment' would consist in extracting as much as is economically possible by method *a* before submitting the ore to method *b*."

E. M. HAMILTON.
San Francisco, Calif.

■

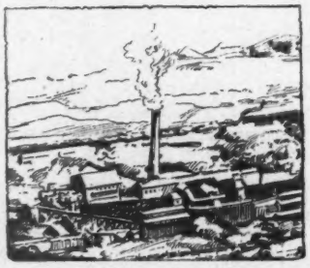
An Experience and a Moral

To the Editor of "E.&M.J.":

Referring to your editorial on "Relation of Ground Movement to Shaft Position":

When I bought the Divisadero mine, in Salvador, the pump shaft was in the hanging wall 1,000 ft. from the outcrop of a big vein dipping 45 deg. The unwatering of the shaft had been a tragedy. The shaft at 100 meters made 300 gal. of water in the dry season, and 600 gal. in the wet months.

A series of accidents to the English company during the life of the manager, Geoffrey Morgan, of Morgan Brothers of London, resulted in the death of two divers sent down to clear the pumps and finally forced the closing down of the property. Before doing this, however, a 12-in. Cornish pump and column was sent out to Salvador, but all the parts never arrived. I later put in a complete equipment of Sulzer centrifugal pumps to raise in 100-meter stages, two vertical sinkers and two horizontal pumps, protected by a steam hoist, electric and hand winch, all connected by cable to the sinkers.



I put the shaft down to 200 meters, and by that time the Morgan shaft had cost me $100,000, and protected the whole workings for about 4,000 ft. Our main shaft had reached 700 ft. in depth, and we were hoisting from 9,000 to 12,000 tons a month. Mr. Frank M. Perry, our efficient manager, had the cost around $4 a ton, inclusive of everything. The treasury, with $100,000 in cash, had just started to pay dividends.

Mr. Perry left, and new management stepped in. I had always maintained specialists from the Sulzer plant to run the pumps. One Sunday, while taking a sleep in the mansion at Virginia City, Nev., I was awakened by my secretary. A rush cable was handed to me which read, "Morgan shaft is flooded and the pumps are lost." With two pumps, either one of which would handle the water with a reserve safety sump 200 ft. long, level with the pumps, the Sulzer man elsewhere, the pumps in charge of a native, all the care and foresight and expenditure to safeguard the mine were wasted. The normal water level was about 150 ft. The water rapidly backed up through the crosscuts, and before we could get in steam sinkers, 400 ft. of the mine was full of water. Each day's shutdown meant $2,000.

We finally got a Byron-Jackson sinker in our main incline and commenced to unwater. As we unwatered, the whole hanging wall country commenced to settle. Our Morgan pump shaft closed up from the shifting and moving hanging country and was lost, but we managed to pull the pumps.

The mine treasury was emptied of its surplus, and Divisadero never made another dollar. I should never sink a shaft in a hanging wall again. I was sinking the main incline 100 ft. back in the hanging wall and I had a splendid Gould pump ready for installation. It is still rusting itself out at Divisadero.

Divisadero was afterward sold for $500,000. The vein is 100 ft. wide at the 700-ft. level. The new company will no doubt open it up again from the footwall incline.

CHARLES BUTTERS.
Oakland, Calif.

New Publications

GEOCHEMISCHE MIGRATION DER ELEMENTE, PART I. *Abhandlungen zur praktischen Geologie und Bergwirtschaftslehre, Band 18. By A. Fersmann. Halle (Saale): Wilhelm Knapp. Pp. 116.*

THE purpose of this first volume is "to furnish reliable material for the foundation of the principles" of geochemical relations in the earth's crust, by a critical description of several mineral deposits in Russia, where the migration of the various chemical elements is particularly well displayed.

After a general introduction, the alkaline rocks of the Chibina tundra (peninsula of Kola, northwestern Russia) and their pegmatites are discussed. These rocks are characterized by an anomalous sequence of crystallization: (1) Nephelite, (2) potash feldspar and albite, (3) albite, (4) zirconium silicates, (5) titanium silicates, (6) soda-iron silicates, (7) volatile constituents. This is not only the guiding principle for the mineral composition of the subsequently intruded rocks, but determines also the mineral composition of the pegmatic dikes. Thus, the earliest consolidated portions are schlieren of nephelite, whereas the later crystallized portions of the magma are increasingly rich in titanium silicates, aegirite and arfvedsonite, and the last pegmatites are extremely rich in iron, lime, and magnesia. Phosphorus may join these last emanations. The concentration of iron in the end-stage formations is of considerable economic importance.

Next, the emerald mines near Ekaterinburg (now called Swerdlowsk), in the Ural Mountains, are described. These mines are in a belt of biotite schist, which trends north-northwest by south-southeast. To the east of the belt, a mass of pyroxenite and dunite outcrops; to the west a mass of granite appears. The granite sends numerous pegmatitic tongues, dikes, and irregular offshoots into the schist, and the chemical reactions between the igneous juices and the schistose series, rich in magnesia, calcium, and iron, are described in detail. The schist displays a definite order or zoning in the vicinity of the granitic pegmatites. Next to the pegmatite is found a black layer of biotite, which is the chief emerald-bearing rock. The second zone is actinolite schist; a third zone of chlorite schist and, finally, talcose schists are recognized. This zonal arrangement is interpreted as a result of Bowen's reaction principle and the local effect of the contact on the magma. The granitic juices give off silica, potassium, water, phosphorus, sulphur, chlorine, fluorine, lithium, and beryllium and boron. "Instead of the combination pegmatitic rest magma plus dunite-pyroxenite, there appear at from 500 deg. to 600 deg. (1) a desilicated pegmatite (albitite or plagioclasite), which has given off the volatile constituents; (2) biotite and quartz, partly in connection with the easily migrating constituents (fluorite, beryl); (3) actinotite, chlorite and talcose rocks which originate as end-stage products of the hydrolysis and disilication of the pegmatitic juices in the country rock."

Similar instances of chemical reactions between granitic rocks and basic wall rocks are reviewed. The igneous rock is always poorer in silica; and biotite, actinotite, talc and chlorite are characteristic for the wall rock. Also, effect on calcareous wall rocks is passed in review.

Swerdlowsk's emerald mines are only one link in a long chain of similar pegmatite occurrences in the eastern Ural Mountains that extends southward into the Kirgise steppe. The principle of the chemical exchange of the elements "serves not only as a foundation of the mining methods, but will guide the search for new deposits."

The proposed second volume is to describe the uranium mine of Tuja-Mujun (Turkestan) and the sulphur deposits of the Karakumy desert (east of the Caspian Sea).

In style, the book is stimulating; the modern literature on the whole subject of geochemistry is masterly governed, and the brief text embodies the result of over nine years' experience in all parts of Russia. DR. ROBERT BALK.

ORE DEPOSITS OF MAGMATIC ORIGIN. *By Dr. Paul Niggli. Translated from the German by Dr. H. C. Boydell. London: Thomas Murby & Company. New York: D. Van Nostrand Company.*

FOR the most part, this book is an adaptation of lectures held at the Swiss Federal Technical University during the winter term of 1923-24. Dr. Robert L. Parker co-operated with Dr. Boydell in the preparation of the English text. The lectures originally appeared in book form as Vol. 1 of the "Abhandlungen zur praktischen Geologie und Bergwirtschaftslehre," published by Wilhelm Knapp, Halle.

Doctor Boydell, in a foreword, quotes from Francis Bacon and Theodore Roosevelt, in stressing the debt one owes to one's profession. The motive conveyed in such quotations, he feels, could find useful expression in showing "that research in the geology of ore deposits can give clearer ideas about the origin of ore, that there is more in the proper application of geology to mining requirements than the usual mere mapping of rock contacts and faults, and that mining companies are doing a distinct disservice to the metal-mining industry by their present attitude of indifference toward and neglect of geological research with respect to their chief asset, their ore deposit. The presentation of a point of view that envisages as necessarily connected phenomena in the formation of magmatic ore deposits that stewing in the magma chamber (Magmaherd) which is called rock differentiation; those crustal movements which come under the heading of earth tectonics, the emplacement of the different kinds of rock previously brewed in the magma chamber; the subsequent production of ore-forming solutions, as a later, or last, stage of differentiation; and then, finally, by the permeation of such solutions, the installment of a tenant, in the form of an ore deposit, in the abode or structure, previously prepared by folding or rock intrusion—all this material cannot fail to be of absorbing interest to mining engineers."

GEOLOGIC STRUCTURES. *Second Edition By Bailey Willis and Robin Willis. New York; McGraw-Hill Book Company. Pp. 518. Price $4.*

THE first edition of this book was a good work on structural geology. The second edition, however, coming six years later, is definitely superior. This is due in part to the advancement of ideas concerning certain phases of the subject, and in part to a more precise consideration of some of the problems of structural geology and earth dynamics.

The authors have placed their information in four major sections. Section I, dealing with the general subject of "Descriptions of Rock Structures," treats the common structures of stratified, igneous, and metamorphic rocks in turn. Nearly one hundred pages are given to the description and technical discussion of faults.

Section II comprises "The Mechanics of Rock Deformation," and deals with the problem of the mechanical principles and the primary types of rock deformation, together with an analysis of folding and faulting. Chapter IX of this section, on "Mechanical Principles" gives, in ten pages, a clear, concise statement of stress, strain, torsion, equilibrium, and associated terms. It discusses stress axes and strain axes and briefly outlines torsion. The reader's understanding of these terms is made clearer by the inclusion of numerous figures. Section III, on "Field Methods" and "Graphic Methods and Practical Problems," is in contrast with the more theoretical sections I and II and the philosophic chapters of Section IV.

Practical problems typical of those

arising in working out structural relations are stated and solved. These include: plotting a dip in a section not at right angles to the strike, finding the direction and amount of displacement on a fault when the direction of movement and the offset portions of a vein are known.

The 80 pages of Section IV, devoted to "Major Problems of Earth Dynamics," take up earth genesis, constitution of the earth, and other similar subjects in which the imagination, experience, and common sense of the individual determine to a large extent the value of the conclusions. It is in these fields, where we have only limited data, that the great experience of the authors is most valuable.

Appendix I is a table of corrections for dip in a direction not perpendicular to strike. Appendix II discusses the angle between the shearing plane and the direction of initial pressure. Appendix III lists with plates a series of laboratory experiments on folding and faulting. DONALD M. FRASER.

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TIN. *By C. L. Mantell. American Chemical Society Monograph Series. New York: Chemical Catalog Company. Pp. 336. Price $7.*

THIS volume is the fifty-first of the monograph series being prepared under the direction of the American Chemical Society. In it has been compiled in readily accessible form a comprehensive treatise on tin, the eighteen chapters covering: The history of tin; physical and chemical properties of the metal; production, distribution, and consumption; ores and ore deposits; mining and ore-dressing; smelting and metallurgy; gaseous reduction; electrolytic refining; plating; alloys; hot-dipped coatings; foil and collapsible tubes; compounds; corrosion; corrosion of tin plate by food products; secondary tin; detinning of tin plate scrap; and, analytical methods.

In the preface the author states that in the chapters on ore and ore deposits, mining and ore-dressing, and smelting and metallurgy these subjects have been treated from the point of view of the metallurgical chemist rather than from that of the mining engineer. Reading of these chapters, however, reveals that the viewpoint of the mining engineer has fared exceedingly well, and the prediction is made that the mining industry will find these chapters, as well as the entire volume, of much usefulness. Numerous maps, plant and equipment photographs, flow sheets, and other illustrations are included in the text. Numerous footnotes, which in themselves comprise an excellent bibliography on the subject of the volume, and an index of authors, in addition to a subject index, add materially to the value of the book for reference purposes.

The volume marks a successful attempt to gather together as much as possible of the authoritative available information for the use of those in the various fields in which tin finds application.

Patents

Filter Press. No. 1,734,325. Nov. 5, 1929. Hugh Harley Cannon, assignor to Oliver United Filters, Inc.
Design for a tubular filter press.

Rotary Pump. No. 1,734,000. Nov. 5, 1929. Ephraim J. Scott, assignor to A.L. Smith Iron Works, Chelsea, Mass.
Design for a valveless rotary pump.

Rock Drill. No. 1,733,402. Oct. 29, 1929. Omar E. Clark, assignor to Gardner-Denver Company, Denver, Colo.
Design for a rock drill.

Flotation Machine. No. 1,732,893. Oct. 22, 1929. Harry D. Hunt, Miami, Ariz.
A flotation machine with central air lift for agitating the pulp.

Copper Melting Furnace. No. 1,733,-419. Oct. 29, 1929. Hiram S. Lukens and Russel P. Heuer, Philadelphia, Pa.
A continuous furnace for smelting copper.

Car-dumping Apparatus. Nov. 1,736,-111. Nov. 19, 1929. Robert W. Capper, assignor to Industrial Brownhoist Engineering Corporation, Ohio.
A rotating cradle for dumping cars.

Thickener. No. 1,734,044. Nov. 5, 1929. William S. Orr, assignor to Central Alloy Steel Corporation, Massillon, Ohio.
A mechanical thickener.

Dry Concentrator. No. 1,733,380. Oct. 29, 1929. John H. Macartney, assignor to American Dry Concentrator Company, San Francisco, Calif.
Design for an ore concentrator table.

Concentration Apparatus. No. 1,736,-111. Nov. 19,1929. Thomas Malcolm Davidson, Hatch End, England.
An endless stratifying conveyor, transversely reciprocated, and partly submerged in a tank filled with liquid.

Roasting Furnace. No. 1,734,552. Nov. 5, 1929. George Balz, assignor to Balz-Erzröstung Gesellschaft, Gleiwitz, Germany.
Design for a mechanical multiple-hearth roasting furnace.

Rabbling Mechanism. No. 1,733,352. Oct. 29, 1929. Hugh R. MacMichael, assignor to American Smelting & Refining Company, New York, N.Y.
A mechanical rabbling arrangement for Scotch hearth.

Zinc Furnace. No. 1,733,500. Oct. 29, 1929. Heinrich Koppers, assignor to The Koppers Development Corporation, Pittsburgh, Pa.
A furnace for reduction and fractional distillation of zinc and other volatile metals.

Filtering and Thickening Apparatus. No. 1,734,999. Nov. 12, 1929. Graham Cruickshank, assignor to Genter Thickener Company, a corporation of Delaware.
A method of agitating the pulp in a Genter thickener to facilitate the removal of solids from the filter elements.

Pulverizer. No. 1,735,985. Nov. 19, 1929. Horace Waring, assignor to Associated Lead Manufacturers, London, England.
Design for a high-speed disintegrator.

Miner's Fuse Pliers. No. 1,732,676. Oct. 22, 1929. John F. Erbele, Beulah, N. D.
A tool for cutting and slicing fuse and for crimping dynamite caps.

Roasting and Reduction Furnace. No. 1,732,672. Oct. 22, 1929. Bror Christiansen, Smedjebakken, Sweden.
A channel furnace having zones of preheating, roasting, prereduction, and final reduction.

Electrolytic Cell. No. 1,732,797. Oct. 22, 1929. Frederic A. Eustis, Milton, Mass.
An electrolytic cell with diaphragm and an arrangement for maintaining correct spacing of the diaphragm.

Tooth for Crushing Rolls. No. 1,736,-563. Nov. 19, 1929. George Wilmot, assignor to Wilmot Engineering Company, Hazleton, Pa.
Design for a tooth for crushing roll having cutting edges.

Roasting Furnace Construction. No. 1,732,843-4. Oct. 22, 1929. Ernest Halse, assignor to Bethlehem Foundry & Machine Company, of Pennsylvania.
Construction of a furnace shaft and means for securing rabble arms.

Electric Furnace Lining. No. 1,732,-623. Oct. 22, 1929. Milton Tilley, assignor to National Malleable & Steel Castings Company, Cleveland, Ohio.
An acid bottom lining consisting of firebrick laid in a fireclay grouting.

Beneficiation of Manganese Ores. No. 1,736,615. Nov. 19, 1929. Leonard B. Miller and William G. Reinhardt, assignor, to Leonard B. Miller, Cleveland, Ohio.
Clay and other foreign material is removed from manganese ore by crushing and washing.

Filter. No. 1,734,652. Nov. 5, 1929. Ernest J. Sweetland, assignor to United Filters Corporation, New York, N.Y.
A filter with a stationary casing, containing an open rectangular frame with filter leaves that is designed to rotate in the casing.

Recovering Zirconic Oxide. No. 1,732,-662. Oct. 22, 1929. Friedrich Rusberg and Paul Schmid, assignors to Kali-Chemie, Berlin, Germany.
Process for the recovery of zirconic oxide, in which hydrochloric acid and a sulphurous compound are used.

Production of Aluminum Hydrate. No. 1,732,772. Oct. 22, 1929. Erik Ludvig Rinman, Djursholm, Sweden.
Production of pure aluminum hydrate by treating aluminum containing materials high in silica with sulphuric acid, and then purifying the solution with sodium sulphydrate.

Car Dump. No. 1,735,778. Nov. 12, 1929. Glenn W. Merritt, assignor to Mine Safety Device Company, Bowerstown, Ohio.
Design for a rotary car dump.

Mine Ventilating System. No. 1,735,-927. Nov. 19, 1929. Louis Kessler, Chicago, Ill.
Design for a ventilating system for mines.

Digest of Current Technical Literature

Selected from abstracts of articles in the leading technical periodicals, prepared by Engineering Index Service, American Society of Mechanical Engineers, 29 West 39th St., New York, N. Y.

Iron Deposits in Africa—North African Iron Ores, E. W. Jackson. *Iron and Coal Trades Review.* Vol. 119, No. 3,219, Nov. 8, 1929.

BRIEF notes on iron-ore deposits, usually hematite or limonite, extending from Morocco to Tunis; prediction that present production of 800,000 tons from Morocco will be doubled in 1931; of five important deposits in Algeria, Ouenza is largest and has reserve of 50,000,000 tons and yearly output about 1,000,000; in Tunisia, Djerissa and Douaria ores are both low in phosphorus, but latter contains large amount of arsenic.—E.I.S., New York.

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Mines and Mining: Haulage — Modern Haulage Equipment in Lignite Surface Practice, W. Franke. *Fördertechnik.* Vol. 22, Nos. 20 and 22, Sept. 27 and Oct. 25, 1929.

LAST year's increase on lignite transportation brought about mainly through increase of capacity of haulage equipment; example taken from Mine Kraft 11 of Niederlausitzer mine; caterpillar bucket dredge with details of caterpillar design and new system of steering; unloading of coal through slewing transporter; large-capacity car of 35 cu.m. with details of construction.—E.I.S., New York.

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Lead-Copper Deposits in the Belgian Congo—Lubi and Lukula Lead-Copper Deposits, Their Origin and Their Relation to Stratigraphy of the Region, E. Polinard. *Annales de la Société Géologique de Belgique.* Vol. 52, No. 11, 1929.

REGION extending 6 km. immediately south of junction of Lubi and Lukula rivers, bounded by Mulongoi and Tshiniame; stratigraphy; La Basanga and Mulongoi deposits; N'Tendu ore occurrence, regarded as float mineral and not ore deposits in place; discussion of associated minerals and theory of origin of deposits.—E.I.S., New York.

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Gold Mines and Mining in Ontario — The Pickle Lake-Crow River Area. M. E. Hurst. *Canadian Mining Journal.* Vol. 50, No. 46, Nov. 15, 1929.

AREA in district of Patricia, about 140 miles northeast of Sioux Lookout station on the Canadian National Railway; geological data; quartz veins in greenstones; some veins are gold-bearing, and others carry practically no value; brief notes on exploration and development.—E.I.S., New York.

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Chromite Deposits in Canada — The Obonga Lake Area. A. R. Graham. *Canadan Mining Journal,* Vol. 50, No. 44, Nov. 1, 1929.

BRIEF description of area 26 miles south of Collin station on Canadian National Railway; geological notes; four veins uncovered, 10 in. to 2 ft. wide, showing average of 34 per cent chrome oxide with favorable ratio of iron chromium; deposits are regarded as uncommercial at present, but of importance as future reserves.—E.I.S., New York.

Mines and Mining, Deep: Ventilation—The Engineering Aspect of Dealing With Temperature and Humidity Conditions of Mine Atmospheres at the Great Depths Associated With Some of the Gold Mines of the Witwatersrand, J. H. Dobson. *Jour. Chem., Met and Min. Soc. of S. Africa.* Vol. 30, No. 2, Aug., 1929.

MATHEMATICAL study of heat exchange in mine air, rock, and rock surface, and bodies of miners; refrigeration of mine air; economic limit of quantity of air for ventilation; refrigeration of air supply at surface; cooling effect of compressed air; use of liquid air; use of ice; direct cooling of workers.—E.I.S., New York.

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Engineers: United States—Engineers in American Life. L. W. Wallace and J. E. Hannum. *Mechanical Engineer.* Vol. 51, No. 12, Dec., 1929.

RESULTS are given of statistical study of 2,858 engineers and architects in "Who's Who in America"; education, academic and honorary degrees, membership in honorary fraternities and scientific societies, and positions in government service and industry are studied.

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Mines and Mining in South Africa — The Future of Mining in South Africa, H. Pirow. *Jour. Chem. Met. and Min. Soc. of S. Africa.* Vol. 30, No. 2, Aug., 1929.

ANALYSIS of mineral production since 1891 shows that Transvaal contributed 79 per cent of total; proportion was gold 71, diamonds 20, coal 6, and other minerals 3 per cent; much wealth from mineral production has remained in South Africa; analysis of distribution; review of mineral resources and problems of mine operation; future of South Africa as mining community is in production of base minerals and manufacture of finished articles.—E.I.S., New York.

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Iron Deposits in Brazil — Iron and Manganese Deposits of Brazil, E. P. de Oliveria. *Echo des Mines et de la Métallurgie.* Vol. 57, No. 3,004, Sept. 1, 1929.

IRON deposits constitute largest mineral resource of Brazil; outline description of principal iron and manganese ore deposits; typical analyses of manganese ore. Abstract of paper read before International Geological Congress in Madrid.—E.I.S., New York.

•

Mine Ventilation: Fans — Extraction Fan for Inflammable Gases. *Engineering.* Vol. 128, No. 3,330, Nov. 8, 1929.

DETAILS of fan produced by S. G. Leach & Co., having flame-proof electric motor, and designed to meet requirements of Home Office and of Mines Department, Sheffield; it is of free-intake type, with four-bladed propeller of somewhat unusual design.—E.I.S., New York.

•

Mineral Industry in South Africa—The Relation of South African Minerals to Empire Requirements, T. Holland. *Jour. Chem. Met. and Min. Soc. of S. Africa.* Vol. 30, No. 2, Aug., 1929.

REVIEW of relation of minerals to world war and to future preparedness and maintenance of imperial prestige; general discussion by members, touching upon specific mineral industries.—E.I.S., New York.

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Pebbles—American Source of Grinding Pebbles, G. B. Bowers. *Rock Products.* Vol. 32, No. 21, Oct. 21, 1929.

LARGE supply exists on beach near Encinitas, Calif.; hundreds of carloads of pebbles are gathered annually from mile of Encinitas beach; pebbles delivered at near-by railway station sell for from $8 to $10 per ton.—E.I.S., New York.

•

Iron Mines and Mining (Production Statistics) in Spain—Economic Statistics of Spanish Iron-Ore Mining, With Special Reference to District of Bilbao, Keyser. *Zeit. für das Berg- Hütten- und Salinenwesen.* Vol. 77, No. 1, 1929.

ORE ANALYSIS and statistical data on mining production and exports during last 50 years.—E.I.S., New York.

•

Zinc-Ore Treatment: Roasting — Problems in Roasting Zinc Ores, G. Balz. *Metall und Erz.* Vol. 26, No. 17, Sept. 1, 1929.

DISCUSSION of problems involved in roasting of zinc ores; this includes roasting zinc blende to obtain metallic zinc by distillation between 800 and 1,000 deg. and roasting mixed and complex ores to obtain metallic zinc by electrolysis at temperatures between 600 and 800 deg.—E.I.S., New York.

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Nickel Deposits — World Deposits of Nickel, H. Carlborg. *Jernkontorets Annaler.* No. 10, 1929.

BRIEF history of nickel; description of nickel ore minerals, nickel-mining and refining processes; use of nickel and nickel alloys; geology of nickel deposits; mine production statistics are given for years 1913 to 1927; present yearly consumption is 40,000 tons. Bibliography.—E.I.S., New York.

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Rock Drills, Pneumatic—Rock-Drilling Machines, L. Nordenfelt. *Teknisk Tidskrift.* Vol. 59, No. 32, Aug. 10, 1929.

DESCRIPTION of several different makes of machines, comparing them and showing method of testing.—E.I.S., New York.

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Diatomaceous Earth Products — Floatstone Company Prepares Industrial Products From Diatomaceous Earth, G. F. Sondraker. *Pit and Quarry.* Vol. 19, No. 4, Nov. 20, 1929.

COMPANY owns deposit approximating four million tons of high-grade earth the predominating diatomic structures of which are technically classed as Cascinadiscus and Synedra; crude earth is mined from main working tunnel measuring 8x8 ft. and extending into hill for about 300 ft.; milling

practice; company is producing two principal products: one for use of concrete admixture, and other for filtering purposes. —E.I.S., New York.

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Hydrogen-Ion Concentration — Determination of Hydrogen-Ion Concentration by Colorimetric Method, F. Benitez. *Boletin Minero de la Sociedad Nacional de Mineria.* Vol. 45, No. 362, June, 1929.

HYDROGEN-ION concentration is defined; mathematical discussion of pH; tabular approximate value of pH of various acids and bases; buffer action; description of method, with various color indicators; application of pH in flotation ore treatment. Bibliography.—E.I.S., New York.

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Iron-Ore Treatment: Apatite Recovery —Investigations on Relations Between Adsorption, Wetting, and Flotation. W. Luyken and E. Bierbrauer. *Metall u. Erz.* Vol. 26, No. 8, Apr. 2, 1929.

IN WORKING out method for recovery of apatite from Swedish slime waste by application of a sodium palmitate flotation process, the authors find usual relations of adsorption influence, wetting, and floatability to hold for this material. See also succeeding article by same authors, pp. 202-203, on Flotative Recovery of Apatite.—E.I.S., New York.

•

Tin Mines and Mining in Argentina— Possible Development of Tin Mining in Argentina, L. Kittl. *Revista Minera Sociedad Argentina de Mineria y Geologia.* Vol. 1, No. 2, Aug., 1929.

GENERAL discussion of occurrences of tin ore in Argentina, with emphasis on recent discoveries in Fiambala region; statistics of tin production of world and notes of principal producing regions, particularly Bolivia; tin veins in Sierra de Zapata and Fiambala district of Argentina are compared with deposits of Caracoles Tin Company in Bolivia.—E.I.S., New York.

•

Silver Mines and Mining in Chile — Condoriaco Silver Mining and Milling Company. *Revista Financiera, Salitre y Minas.* Vol. 4, No. 37, June, 1929.

MINING property northeast of city of La Serena, 25 km. from Almirante Latorre station; brief description of ore deposits, mining, and milling; production data for May, 1929, are given as example.—E.I.S., New York.

•

Quarries and Quarrying in New York State—Converting a Profitless Quarry Operation to Hopeful One. *Rock Products.* Vol. 32, No. 23, Nov. 9, 1929.

MOBILIZATION of quarry equipment at Albany Crushed Stone Co., Feura Bush, N. Y., proves success possible; there are four motor trucks in use; all four-wheeled, 7½-ton Macks equipped with Phoenix steel bodies of 8-cu.yd. capacity.—E.I.S., New York.

•

Mineral Resources of Mexico—Mining Geology of Region Between Durango, Durango, and Mazatlan, Sinaloa, on Both Sides of Projected Highway Between Those Cities, M. Santillan. *Instituto Geologico de Mexico*—Bulletin No. 48, 1929.

RICH mining region in Sierra Madre mountains; little precise information has been published: history and climate, description of various mining districts: general geology and geographic distribution of ore deposits. Bibliography.—E.I.S., New York.

•

Gold Mines and Mining in France — Gold Mining Industry Revival in France. *Echo des Mines et de la Metallurgie.* Vol. 57, No. 3,010, Nov. 1, 1929.

GOLD deposits occur in eight regions in France; greatest activity in Haute-Vienne department; notes on developments and company operations in various districts of France; tabular production data for 1928.—E.I.S., New York.

•

Salt Deposits of Argentina — Bebedero Salt Deposit and Its Relations With Andino or Desaguadero Hydrographic System. *Republica Direccion General de Minas, Geologia e Hidrologia.* No. 47, 1929.

REPORT on investigation of salt deposit near city of San Luis in province of same name; analyses of samples from various points; comparative graphs; theory of origin; hydrographic study. Bibliography.—E.I.S., New York.

•

Graphite (Tariff) United States—Higher Duty on Graphite Threatens. *Foundry.* Vol. 57, No. 3,010, Nov. 1, 1929.

DISCUSSION of changes made in tariff bill now before Congress regarding graphite; abstracts are given of several reports issued by U. S. Bureau of Mines, and edited by P. M. Tyler, which show unsuitability of domestic graphite for manufacture of crucibles and foundry facings.—E.I.S., New York.

•

Geophysical Exploration, Electric—The Electric Resistance Method of Geophysical Surveying, G. T. Tagg. *Canadian Mining Journal.* Vol. 50, No. 49, Dec. 6, 1929.

GENERAL notes on gravimetric, acoustic, seismic, and electrical methods; description of electrical resistance methods; Gish and Rooney apparatus; Megger earth tester; notes on field test; reference to U. S. Bureau of Mines Tech. Paper No. 440.—E.I.S., New York.

•

Gold-Ore Treatment in Colorado—Ore Treatment Methods and Practice in the Golden Cycle Plant, M. F. Dycus. *Mining Congress Journal.* Vol. 15, No. 12, Dec., 1929.

TREATMENT of complex ores determined by sampling of each shipment; separate roasting controlled by screening; disposal of tailings special problem; telluride concentrate made from low-grade ores, before roasting.—E.I.S., New York.

•

Engineering Societies of Argentina — Bases for Organization of Argentina Geological Institute, L. R. Catalano. *Revista Minera Sociedad Argentina de Mineria y Geologia.* Vol. 1, No. 2, Aug., 1929.

NOTES on establishment of Division de Minas, Geologia e Hidrologia by Argentine government, as corollary of enactment of mining law; discussion of functions of proposed geological institute, under general head of Applied Geology, Descriptive Geology, and Geological Instruction; cooperation with government departments and bureaus is considered as important and essential, for welfare and benefit of entire nation.—E.I.S., New York.

•

Granite Quarries and Quarrying: Health of Workers — Health of Workers in Granite Industry. *Monthly Labor Review.* Vol. 29, No. 6, Dec., 1929.

EFFECTS of different types of dust upon health of workers are being studied by U. S. Public Health Service; these include not only study of occupational mortality statistics of particular industry and physical examination of employees but observation of workers for extended period in order to ascertain character and severity of sickness they experienced and relationship of such illness to occupational environment.—E.I.S., New York.

•

Asbestos Industry in Europe — The Continental Asbestos Industry, Brueckner. *India Rubber Journal.* Vol. 78, No. 17A, Oct. 31, 1929.

EARLY history and present studies of asbestos industry in Germany, Austria, France, Belgium, Italy, Hungary, Poland, and Russia.—E.I.S., New York.

•

Feldspar — Feldspar in Modern Manufacturing Industries. *Pit and Quarry.* Vol. 19, No. 4, Nov. 20, 1929.

SPAR rock is mined by open and tunnel methods, operation itself being somewhat different from mining of coal, iron ore, and other such minerals. Excerpts from circular issued by Feldspar Grinders' Institute.—E.I.S., New York.

•

Mineral Deposits of Argentina—Metallurgical Report on Tin, Tungsten, and Bismuth Mines in Sierra de Velasco, La Rioja Province. S. Waessman. *Direccion General de Minas, Geologia e Hidrologia.* No. 45, 1929.

MAZAN vein deposits are low grade; alluvial deposits near Shaquis can yield high-grade tin concentrates, but are small; metallurgical project is not justified; oxide and carbonate bismuth ore near San Blas de los Sauces and Shaquis, not suitable for wet concentration; doubtful whether production and export of metallic tungsten from Cantadero mines would be success, but ore export is feasible.—E.I.S., New York.

•

Drilling, Diamond—Use of Borings in the Underground Workings of the Bruay Mines, Didier. *Echo des Mines et de la Metallurgie.* Vol. 57, No. 3,008, Oct. 10, 1929.

NOTES on practice during last 24 years, during which 14,000 borings were made, with total over 60,000 meters; brief description of drilling machine with 8-hp. compressed-air motor; diameter of holes about 40 mm., giving cores 23 mm. in diameter. Boring was done to obtain geological information to guard against firedamp and water hazards, and as part of mine drainage program.—E.I.S., New York.

•

Emerald Mines and Mining in Colombia —The Chivor-Simondoco Emerald Mines of Colombia, P. W. Rainier. Appendixes by C. Mentzel and C. K. MacFadden. *A.I.M.E.* Tech. Pub. No. 258, 1929.

EMERALD field in department of Boyaca, on eastern slope of Andes; early mining operations; production gradually increasing: occurrence and grades of emeralds; mining methods; thefts infrequent; labor supply variable; characteristics of native workers; future possibilities; geology of Chivor No. 1 mine by Mentzel; brief review of emerald mining in Colombia, by MacFadden. Bibliography.—E.I.S., New York.

Personal Notes

Byron A. C. Johnston arrived recently in New York from Morococha, Peru.

W. A. Quince, general manager of Sub Nigel, on the Witwatersrand, Transvaal, has resigned.

R. G. Lemmon leaves London early in January on a short professional visit to New York and Canada.

G. C. Klug, managing director of Bewick Moreing & Company, is on a business trip to Australia.

G. C. Barnard, formerly with the Nile Congo Divide Syndicate, has left England for the Belgian Congo, via Rhodesia.

C. A. Mitke, of the staff of Mining Trust, Ltd., sailed from New York on Dec. 27, on the "Mauretania," for London.

Robert F. Lethbridge is on the staff of the Selection Trust, Ltd., operating the Stantrg mine, at Janjevo (Kosovo), Yugoslavia.

J. H. Gibbons has left Shamva Mines to accept an appointment as Inspector of Mines for Northern Rhodesia, with headquarters at Livingstone.

C. E. Jobling, mine manager for Mawchi Mines, Ltd., is returning from London to the company's properties at Mawchi, via Toungoo, Burma.

L. Aldridge, managing director of the British-Swiss International Corporation, Ltd., with **H. L. Burnie,** consulting mining engineer to the corporation, is making a general survey of the mining possibilities of Australia.

Charles Camsell, Deputy Minister of Mines of Canada, leaves Ottawa in February for South Africa, where he will attend the Third Triennial Empire Mining and Metallurgical Congress, as the representative of the Canadian government. **Thomas W. Gibson,** formerly Deputy Minister of Mines for Ontario, and now retained by the Department in an advisory capacity, will represent the Ontario government. The Dominion Department of Mines will be represented at the Congress by **W. B. Timm,** Chief of the Division of Ore Dressing and Metallurgy.

CHARLES CAMSELL

C. J. Barber, formerly with the Mexican Corporation, at Fresnillo, Zacatecas, Mexico, is now with the Compañia de Real del Monte y Pachuca, at Pachuca, Hidalgo.

George C. Heikes, of the Giesche Spolka Akcyjna, Katowice, Poland, is returning to Poland via New York and London, after a short visit to his parents in San Francisco.

Charles Locke, of the Massachusetts Institute of Technology, returned to the United States late in December from Japan, where he attended the World Engineering Congress.

W. C. Douglass, erroneously reported as "Dawson" in the Dec. 21 issue of *E.&M.J.*, has been appointed assistant general manager of Consolidated Coppermines, at Kimberly, Nev.

R. R. Beard, formerly on the metallurgical staff of Patiño Mines & Enterprises, Ltd., at Llallagua, Bolivia, arrived in New York City on Dec. 23. He left late in December, for Morenci, Ariz.

R. R. BEARD

O. H. Adams, formerly with the Compañia Minera y Agricola Oploca, operating in the Chocaya district of Bolivia, has left England for Canada.

Pomeroy C. Merrill sailed from New York late in December for Russia. Mr. Merrill, who will be stationed in Alapaevsk, in the Ural district, has been retained in an advisory capacity by the U.S.S.R., to supervise mining activities in this area.

H. DeWitt Smith, whose appointment as a director of Newmont Mining Corporation was recently announced, has left the staff of United Verde Copper. **W. W. Lynch,** formerly general mine superintendent for United Verde, succeeds Mr. Smith as manager of metal sales.

Lucien Eaton, formerly of the Cleveland-Cliffs Iron Company, has been retained as consulting mining engineer for Roan Antelope and Selection Trust. He has just returned to the United States from a trip to Rhodesia, and expects to sail for Europe on Jan. 11. He will be in Leningrad for two months before going to Africa again.

J. H. C. MACDONALD

J. H. C. MacDonald has recently returned from Paris to Moscow. Mr. MacDonald has his headquarters in Moscow as Chief Mining Engineer for the Giprotzvetmet, the state institute of the U.S.S.R. for the control and projecting of metallurgical plants.

A. W. Harris, construction engineer for Wiluna Gold, operating in Western Australia, recently arrived at the property from London. Mr. Harris began his career with a copper company in the southwestern United States. Later he was in Russia, for an American firm developing a manganese property. His most recent connection has been with New Consolidated Goldfields, Ltd., as consulting engineer.

OBITUARY

Godfrey Gunther, mining geologist, died suddenly on Dec. 26, at Berne, Switzerland. Mr. Gunther, who was interested in archaeological research, was engaged for several years in the reopening and development of the ancient copper mines on the island of Cyprus. He was 49 years of age, and is survived by a small son and a sister.

Kenneth Lancaster Graham, consulting metallurgist to the Central Mining & Investment Corporation, died recently in Johannesburg. Mr. Graham, who was born in Scotland in 1872, had lived in Africa since 1891, when he began his career in Rhodesia. He had been connected with several of the important mines on the Rand, among them the New Primrose, and Geldenhuis Deep. Mr. Graham will probably be best remembered for his research work on the recovery of platinum from various Transvaal ores. He is survived by his widow and one son.

Dr. **Percy A. Wagner,** mining geologist and engineer, of South Africa, died on Nov. 11, after a long illness. Doctor Wagner was born in Richmond, Cape Province, in 1885. He was educated at the South African College, the South African School of Mines, the Royal Mining Academy at Freiberg, Saxony, and at Heidelberg University. He was engaged in private practice as consulting geologist until 1918, and had been geologist to the Mineral Survey of the Union of South Africa since 1918. He is the author of several books, among which are "The Diamond Fields of Southern Africa," and "The Geology and Mineral Industry of Southwest Africa."

INDUSTRIAL PROGRESS

Electrical Industry Shows New Achievements ---Use of Diesel Power Increasing Steadily ---A New Vibrating Screen

REAL PROGRESS — the achievement of something new—hinges on research. The pragmatic worth of the latter is graphically indicated by the fact that in the year just closed more than a fifth of the total income received by General Electric was for electric apparatus which only ten years ago was either unknown or of negligible importance commercially.

SOCIETY takes a step forward as its per capita consumption of electrical energy increases. Such advance during 1929 is indicated likewise by the increased volume and monetary value of electrical equipment produced by the company mentioned. In both respects the figures greatly surpassed the maximum record of any former year, this according to John Liston, speaking for the company. This was the result of increased activities in industry, transportation, and communication.

Generators of Record Size

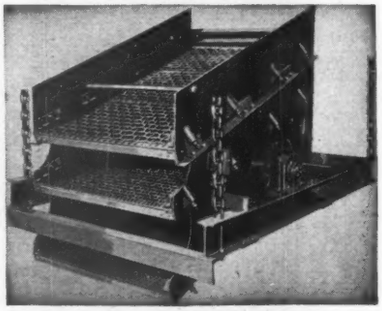
Still another conception of progress is that having regard for the production in larger and still larger capacities of machines already developed and used. This was exemplified by the completion and placing in service last year (by the same company) of two record-size turbine generators — one, a 208,000-kw. cross-compound unit and the other a 160,000-kw. tandem-compound unit. Each was the largest of its type thus far built. Of exceptional interest was the growth in the use of turbines operating at steam pressures of 1,200 lb., the aggregate capacity of such machines completed or under construction being greater than the combined capacities of the preceding six years. Units of such size and of pressures so high are indeed not used at present in metal mining, but such developments cannot help but influence power-plant practice.

Electrification of railways proceeded at an unprecedented rate during the year, a development that registers its effect on the copper-mining industry. New records were made in the number of electric and oil-electric locomotives built.

Practical standards for airway and airport lighting systems were decided upon in the United States by the Department of Commerce, a development worthy of attention by reason of the notable service that aviation is rendering in facilitating prospecting and exploration work. Further development work was done on the radio altimeter designed to minimize the hazards of blind flying.

New Means of Controlling Electrical Energy

Other indicators of progress were the commercial development of the photo-electric tube for controlling circuits through variations in the intensity of light; also in the practical application of the thyratron to the control of lighting systems. Still another step forward was the extension of the use of the mercury-arc power rectifier. Some outstanding accomplishments in lighting were achieved.



A vibrating screen designed for heavy-duty separation

Progress may be negative at times. A case is the discovery, announced in the *E.&M.J.* of Dec. 28, 1929, on p. 1011, that the choke coil, long used in lightning protective systems, was of little actual value in this service. The result has been that its use has been discontinued.

A New Vibrating Screen

BUILDERS and users of machinery for screening bulk materials have long appreciated the advantages of continuously and rapidly agitating the aggregate so as to cause the smaller lumps to settle through the mass and pass the screen surface openings. Pulsation at high speed causes the mass to shift constantly and helps bring all the particles in contact with the screen surface.

Ability to develop positive vibration is a fundamental feature of a new vibrating screen recently introduced by the Stephens-Adamson Manufacturing Company, Aurora, Ill. The necessity of constructing such a machine so that it will withstand the constant vibration has also been recognized. Features of the screen, which is known as the "Vibrator," are in brief as follows: Grid-type screen support; suspended subframe, high-duty self-aligning ball and roller bearings; pressure lubrication to each individual bearing; bronze grease seals; adjustable balancing device; rigid cross member; standard screen panels; quick-action clamps; demountable mechanism; detachable deck construction; adjustable angle of incline; V-belt drive; and inclosed fan-cooled driving motors. The screen is shown in the illustration at the left.

For nearly two years the Stephens-Adamson company has been developing and testing the various features of this screen. The results, it says, have been so satisfactory that it is now ready to announce them.

Advance in the Diesel Power Field

PROGRESS in the power field is marked where the Diesel engine is concerned. This is well indicated in the mining industry. A decade ago Diesel installations at mine plants were rare. Today it is a copper-mining company—the Phelps Dodge Corporation—that is the largest industrial user of Diesel power in the United States, having approximately 40,000 hp. in use, the units being, incidentally, all of one design. Another mining company, the Commerce Mining & Royalty Company, at Cardin, Okla., in the Tri-State zinc district, operates Diesel engines totaling 10,750 hp. in one central power plant. A survey of the power field shows Diesels in use in many other mining, quarrying and allied operations. Included are mines producing gold, copper, lead, zinc, iron, phosphate, graphite, mica and salt, also gold and gravel dredges, granite quarries, sand and gravel plants, stone-crushing plants, and cement mills. Many industrial lines other than mining also are using Diesel power, to an increasing extent.

A Diesel engine of 15,000 hp. is now in service in Europe. In the United States, the largest engines manufactured so far are of 4,000 hp. Engines have been furnished for operation in the United States at altitudes between 250 ft. below sea level and 10,000 ft. above. An interesting installation at near this higher limit was made in 1929 at the East Portal power plant of the Moffat

This truck with its trailer is powered with a crude-oil engine developing 60 b.hp.

Tunnel, Colorado, where an engine of 580 hp. was installed.

Best opportunity for expansion in the use of Diesels in the future would seem to be in the field of portable and semi-portable power. This is quite logical, in that engines of this type, able to hold their own against coal and electric power, are far ahead of gasoline power wherever circumstances favor installations.

The tendency toward portable uses is influencing the design of Diesel engines in that lighter and higher-speed units are being built. Piston speeds of 1,200 ft. per minute are no longer uncommon. In the small sizes, the higher limit to rotative speed is close to 700 r.p.m. and is around 300 r.p.m. for 1,000-hp. units. Of course, Diesel engines for such services as in airplanes and trucks have left these limits far behind.

Industry Now Organized

SUCH growth as the Diesel engine manufacturing industry enjoyed up to 1929 came about in spite of a lack of organization. This condition changed, however, during the year with the organizing of the Diesel Engine Manufacturers' Association (30 Church St., New York). Election of the following officers for 1930 was recently announced:

President, A. E. Ballin, McIntosh & Seymour Corporation, Auburn, N. Y.; vice-president, George Codrington, Winton Engine Company, Cleveland, Ohio; chairman of the executive committee, E. T. Fishwick, Worthington Pump & Machinery Corporation, 2 Park Ave., New York City; chairman of the technical committee, H. W. Dow, Nordberg Manufacturing Company, Milwaukee, Wis.; and secretary-treasurer, H. A. Pratt, Ingersoll-Rand Company, 11 Broadway, New York City.

In a relatively short time, considering the years this industry has been unorganized, the members have agreed upon a number of engineering standards which should be of assistance to buyers. These agreements will be formally presented in the near future in a book entitled "The Standards of the Diesel Engine Manufacturers' Association." The association has also served as a vehicle for collective co-operation with the activities of other agencies. Most noteworthy among these activities is the work of the American Society of Mechanical Engineers in the standardization of fuel oil.

Members of the association have themselves furnished engines for use in every state of the United States and its territories; also, in practically all other countries of the Western Hemisphere and in still other countries in Europe, Asia, and Africa.

Use of Manganese Steel Increasing in Mining

AS A RESISTANT to abrasive wear, manganese steel has established itself extensively in the mining industry. Among the first applications were jaw plates in rock breakers. Subsequently others of a minor sort were made. As experience was gained in the foundry and in the metallurgical work involved in making the manganese-steel parts, applications multiplied. Gold dredging companies were among the first to take full advantage of manganese steel. In the construction of the modern gold dredge practically all parts subject to abrasive wear are now made of manganese steel.

This outlet for the highly specialized foundry producing manganese steel proved advantageous, as it gave tonnage and thus improved the commercial position of the business. Two other factors also contributed to expansion. One was the electric furnace, which gave closer control both of the composition of the metal and the pouring temperatures. It also reduced heat losses and lent itself better to the requirements of the foundry than any other methods of melting. The other factor was the development of high-speed abrasive wheels for both hand and machine grinding. The tough character of manganese steel precludes the use of machine tools. Likewise, the tendency of the metal to warp in the quenching process introduced the difficulty of straightening castings. Some of the warping difficulty is overcome by greater care in design.

The cumulative shop experience, as stated, is now a factor in extending the applications of manganese steel over a wider field. As an example, apron feeders and pan conveyors are now built almost entirely of manganese steel. A recent piece of work, an all-manganese steel skip box, is shown in the accompanying illustration. With the object of obtaining large capacity with minimum weight and still have a wear resistance as great as possible, a skip box to be constructed of manganese steel was designed by H. H. Pratt, chief engineer of the Phelps Dodge Corporation at Douglas, Ariz. Inside dimensions are 4 ft. 1 in. square by 9 ft. depth. Wall thickness is $\frac{5}{8}$ in. The box is in three sections joined by right-angle outwardly projecting flanges and at the corners by 45-deg. flanges. The bottom flange and the corresponding surface at the sides are hand-ground to a straight edge, but the remainder of the joints, both 45 and 90 deg., were machine-ground. To prevent warpage during heat-treatment ribs were cast on the 90-deg. flanges as shown in the illustration. The bottom is made in two pieces with a 90-deg. flanged joint. The hole at the upper end is machine-ground with a square countersink on the inside to take the pin head which projects through it and carries the dump roller. At the top the three flat surfaces support the horns, which are also of manganese steel.

Three skip boxes were made from the design, one being bolted with monel bolts and the other two by steel bolts. They were manufactured at the Oakland plant of the American Manganese Steel Company. The cubic content of the box is 145 cu.ft., or about 7 tons' capacity. It weighs 5,200 lb., or 35.9 lb. per cubic foot of content.

General view of manganese-steel skip box

Crude Oil Engines Drive These Trucks

AUTOMOTIVE engines using crude oil have as yet supplanted the gasoline-driven variety to only a limited extent in the truck field. The crude-oil engine is gaining ground, however, as the accompanying photograph indicates. The truck, or wagon, shown above, is equipped with an experimental crude-oil engine developing 60 b.hp. A standard Garrett four-wheeler and a six-wheeler steam-wagon chassis were used as basis for these trucks. The six-wheeler has an engine developing 80 b.hp.

Both types were supplied by the maker to Barford & Perkins, Ltd., Peterborough (associated with Agricultural and General Engineers, London), in November, 1928. Since then the six-wheeler has covered about 16,000 miles and the four-wheeler about 12,000 miles. The former has been used principally for long-distance running, heavily loaded both ways, and the latter for local work. Loads were anything up to 11 tons. The makers of the engines are Richard Garrett & Sons, London, England.

NEWS OF THE INDUSTRY

Summary

A threatened suspension of operations in the Broken Hill district, New South Wales, because of a lack of water, has been averted by heavy rains.

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Low silver prices will throw 7,000 Mexican miners out of work, president of the Mexican mining chamber asserts. Boleo workers will strike, as directors remain adamant.

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High-grade ore has been uncovered by three drifts at the Kansanshi mine, Northern Rhodesia. A. E. Wheeler has been appointed metallurgist of the property.

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Operations at American Metal's Pecos mine, in New Mexico, have been curtailed 50 per cent because of low zinc prices.

* * *

Russia is negotiating for purchase of Bolivian tin ore to supply Ukrainian smelters, according to rumors from La Paz. Consolidation of smaller independent producers is probable.

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New flotation plant at the Soldado mine of Minière du M'Zaita will be ready in April. Property is at Melon, Chile. Company plans large increase in copper output.

* * *

Radium production by the U. S. Bureau of Mines has been proposed by Representative Kelly, of Pennsylvania. Belgian producers are charging exorbitant prices, he avers.

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Recovery of lead and zinc from the complex ore at the Base Metals mine, Field, B. C., has been exceptionally high considering the short time the new 300-ton concentrator has been operating.

* * *

No new ore has been uncovered in the Esperanza mine of Dos Estrellas, in the El Oro district of Mexico, and the outlook for the property is considered dubious by the management.

Lake Shore to Sink No. 3 Shaft to 4,000 Ft.; Work at Other Kirkland Lake Mines

Teck-Hughes Starts Winze to 3,600 Level, New Shaft Now Down Below 2,100 Level—Wright-Hargreaves Still Centering Work on New Development

THAT the trend toward mining at greater depths in the gold mines of the Kirkland Lake district, Ontario, is becoming more pronounced is indicated by a survey of the status of operations at Lake Shore, Teck-Hughes Gold, and Wright-Hargreaves—the three leading producers in the camp. Preparations are now being completed to sink Lake Shore's No. 3 shaft to 4,000 ft. The new 1,100-hp. Nordberg hoist, which has an ultimate capacity of 5,000 ft., is now on the ground ready to be installed. Sinking will start as soon as No. 1 shaft has been raised through from 2,200 ft. The program calls for sinking 400 ft. at a time, and then raising through to No. 1 shaft.

A crosscut on the 2,200 level of the No. 3 shaft has cut the No. 2, or north, vein and shows 12 ft. of high-grade ore. On the 2,000 level drifts are being carried 12 ft. wide, and in many cases the full width of the orebody is not shown. Average grade at this depth is higher than on any of the upper levels.

Construction of the mill addition that will raise capacity to 2,000 tons daily has been delayed by the failure to receive structural steel. The main part of the new building has been inclosed, however. Most of the equipment is at the plant, and installation will soon be started.

Development on the six new levels at Teck-Hughes has shown ore of higher grade recently, and officials are now apparently confident that the average grade will compare favorably with that obtained on upper levels. Two zones, 60 ft. apart, have been proved to the No. 25 level. High-grade ore has been opened on Nos. 23, 24, and 25 levels. Production is running about $455,000 a month, which should be sufficient to maintain dividends.

Sinking of the winze from the No. 25 level has been started at Teck. The winze will be continued to 3,600 ft., at which depth a second connection will be made with the new south shaft, the first connection being made at 3,000 ft. The new shaft, started last autumn, is down below 2,100 ft.

At the beginning of the year the belief was expressed that at least two years of intensive development would be needed to put Wright-Hargreaves in condition, but developments have been favorable and the situation is much improved at this property. On the two new levels in the eastern part of the mine below 2,000 ft. particularly good results have been obtained. Of the thirty drilling machines underground, twenty are on development. As much as 250 tons of $12 ore daily is obtained from development at times. In addition, work in the older sections of the mine is finding new ore, an interesting pocket having recently been cut at 700 ft. More ore was developed than mined this year, and, through better mining methods, a higher grade was obtained. Profits of about $300,000 for the year are anticipated.

■

Final 1929 Figures Show Gain in Tintic, Loss at Park City

Final compilations of shipment totals from the Park City and Tintic districts of Utah during 1929 show an increase in the output from the latter camp, but a decrease of more than 10 per cent in the Park City totals. Tintic shipments aggregated 7,002 carloads of ore and concentrate during 1929, as compared with 6,165 carloads in the preceding year. Augmented shipments of dump material to smelters for use as flux and the higher production at Tintic Standard and North Lily accounted for the increase.

Tintic Standard shipped 1,979 carloads in 1929, compared with 1,940 carloads in 1928. North Lily shipped 1,081 carloads, compared with 698 in 1928. Chief Consolidated, with shipments of 661 carloads, showed a decrease of 33⅓ per cent. Bingham Mines' output fell from 594 carloads in 1928 to 311 carloads in 1929.

Park City production for 1929 was 338,571 tons of ore and concentrate, compared with 379,081 for the preceding year. Park Utah accounted for the entire decrease by dropping its shipments from 274,447 tons in 1928 to 229,390 tons in 1929. Silver King, which ships most of its product as concentrate, shipped 54,250 tons, compared with 52,254 in 1928. New Quincy increased its total from 15,939 to 45,672 tons. Of the smaller mines, Park Galena shipped 2,981 tons and Park City Consolidated 622 tons during the year.

■

New Quincy Starts Work on Little Bell Territory

Three headings are being advanced on the 700 level of the Little Bell property, recently acquired by New Quincy Mining. Little Bell adjoins New Quincy, in the Park City district of Utah. Considerable work is also being done on the 700 level in New Quincy ground. About 60 men are employed, most of them on development work, and 100 tons of silver-lead ore is being shipped daily.

Rhodesian Labor Needs Are Small, Lawn Declares

OWEN LETCHER
Special Johannesburg Correspondent

DRAWING a comparison between the Rand mines and the new copper deposits of Northern Rhodesia, Prof. J. G. Lawn, of Johannesburg Consolidated Investment, asserted at the company's annual meeting in Johannesburg recently that less than 8,000 colored workers would be needed for each 100,000 tons of copper produced annually in Rhodesia. The Rand, he pointed out, is operating at an average depth of 3,500 ft.; only about 50 per cent of the reef is ore; milling width is 40 in.; heavy development is necessary; 18 per cent of the rock broken must be sorted out as waste; and workings are widely scattered. Output per underground colored worker is 200 milling tons annually.

In Northern Rhodesia, however, the copper mines will operate above 1,000 ft. for several years; ore is continuous; milling width is close to 40 ft.; current development is negligible; sorting is unnecessary; and workings are closely grouped. With these advantages, the tonnage per man-shift should be at least three to four times as great on the Rand. Professor Lawn's estimate of 8,000 men per 100,000 tons of copper produced annually is based on a tonnage per man only twice as great.

Professor Lawn dwelt at some length on the situation at Bwana M'Kubwa's N'Kana mine. The length of the strike of the ore-bearing members of the bedded rocks included in the N'Kana area is about 18 miles, of which about 9 miles has been partly developed by surface pits and boreholes, he stated. Three orebodies have been discovered in the 9 miles so far tested, separated by short, barren stretches.

Drilling operations are more advanced on the N'Kana orebody than on the other two, between which it is situated. In all, 31 boreholes have penetrated it, proving a strike of 8,000 ft., a width of 27 ft. and a value of 4.3 per cent copper. Three boreholes have cut the orebody between 2,300 and 2,800 ft., vertical depth. This depth is equal to more than 3,500 ft. on the dip. The ultimate depth to which ore persists has not yet been determined. Orebodies discovered to date will produce at least 100,000,000 tons of more than 4 per cent copper, Professor Lawn believes.

■

Will Hold Science Meeting at Brisbane in May

The Australasian Association for the Advancement of Science will hold its twentieth meeting at Brisbane, Queensland, during the week beginning May 28. E. C. Andrews, government geologist at Sydney, is president-elect of the association, and one of the vice-presidents is Prof. Sir T. W. Edgeworth David, emeritus professor of geology at the University of Sydney. The geology section is under the presidency of E. de Courcy Clarke, of the University of Perth.

■

Coniaurum Sinking Deep Winze

Sinking of a winze from the 2,000 level of the Coniaurum mine, in the Porcupine district, Ontario, will be undertaken by Ventures, Ltd., following a recent examination by its engineers. Ventures holds an option on control of Coniaurum. The first objective of the new winze will be 2,500 ft., with an intermediate level at 2,250 ft. Work on the 2,000 level has been disappointing to date.

■

Propose Bureau Undertake Radium Production

PAUL WOOTON
Special Washington Correspondent

FURTHER production of radium by the U. S. Bureau of Mines is proposed in a bill being urged by Representative Kelly, of Pennsylvania. The bill directs that one gram of radium be produced for the treatment of patients in the hospitals under the jurisdiction of the Veterans' Bureau. An appropriation of $100,000 is to be authorized for the purchase of the necessary equipment and materials.

Representative Kelly states that he is convinced that the Belgian interests controlling the low-cost source of radium are charging unjustifiably high prices for the product. The United States has taken an active part in bringing about the downfall of foreign controls of rubber, coffee, and other commodities. In those instances only the American commercial consumer was victimized. In regard to radium, however, the real victims of the control are the sick and afflicted. For that reason he argues that cause exists for activity on the part of the federal government to curb those who are charging unreasonable prices for radium.

Arrangements have been made for a hearing in January on the Kelly bill by the Mines and Mining Committee of the House. Mr. Kelly believes these hearings will be particularly significant, in that the proceedings will reveal many sensational features of the radium control.

Mr. Kelly states that he has estimates showing that the federal government would be able to produce radium from domestic ores at a cost not to exceed $35,000 a gram. This is approximately one-half the present selling price of the imported product.

Having co-operated very successfully during 1929 with the crushed-stone industry in carrying forward a safety program, the Bureau of Mines is now planning to extend to stone quarries its studies of mining methods and costs. Studies of a technological nature also will be undertaken.

Publication recently of an information circular on beryllium has brought a flood of correspondence on the subject to the Bureau of Mines. Apparently, prospecting for this mineral has been stimulated. A report has been received that a sizable deposit of unknown grade has been found in Manitoba. The chief interest in beryllium is the possibilities offered in airplane construction for a metal of unusual lightness and strength.

■

Kingman to Have "Revival"

Arrangements have been made by the Arizona chapter of the American Mining Congress for a "Mining Revival" to be held in Kingman on March 8 and 9. The first of these revivals, held for the purpose of aiding small operators and prospectors, was given in Yuma two years ago. They have proved popular and have been of great assistance in awakening interest in the importance of the mining industry.

Mexican Unemployment Expected From Low Silver

W. L. VAIL
Special Mexico City Correspondent

Mexico City, Jan. 3, 1930.—The situation created by the drop in the price of silver to 46¼c. an ounce has produced a severe crisis in the Mexican mining industry. Unemployment is expected to result, and Jenaro Garcia, president of the national mining chamber, predicts that 7,000 men will be thrown out of work within the next three months. Real del Monte y Pachuca, at Pachuca, Hidalgo, is considering reducing its force to 350 men by a lay-off of about 700. Jalisco, Zacatecas, and Guanajuato mines are all seriously affected. On Dec. 31, a statement was received by Mr. Garcia from the principal operators in Jalisco, insisting that radical steps had to be taken to aid the industry or a general suspension of operations would result.

Low prices for zinc have not added to the cheer of the situation, although San Francisco Mines of Mexico has been considering erection of a zinc smelter near the United States border, possibly at Juarez, Chihuahua.

From Santa Rosalia, Lower California, reports have been received that on Jan. 6 miners at the Boleo Copper property will strike. Directors of the company in Paris refuse to accede to the various demands of the workers. Boleo has been troubled by labor dissensions for the last two or three years.

San Rafael y Anexas, of Pachuca, is conducting an examination of the Victoria lead-zinc property, State of Tamaulipas. This property has been examined by various interests several times, but the lack of effective transportation facilities has retarded development. A cable tramway may be built to the railroad.

■

Central Patricia Preparing to Sink Shaft to 500 Ft.

Sinking of a shaft to 500 ft. in depth, with subsequent lateral work amounting to about 3,000 ft., is the principal part of the program outlined by W. E. Segsworth, general manager, for the Central Patricia property, in the Patricia district of northwestern Ontario. Shaft sinking should be completed by June 1, as equipment for carrying on the work is now awaiting shipment over winter roads. To finance this work, stockholders are being offered new shares at 25c. in the ratio of one new share for each five shares now held. A total of 600,000 shares are being offered thus.

According to official statements, the ore has been traced for 557 ft. on the surface, showing an average width of 17 ft. and an average grade of $12.50. Diamond drilling has indicated 680 ft. of ore at the 250 level, with an average width of 6.8 ft. and an average grade of $15.

■

Yellow Aster Adds Cyanide Unit

A cyanide unit will be added to the milling equipment of the Yellow Aster mill, near Randsburg, Calif., according to W. F. Allen, superintendent of the property. Capacity of the mill is about 125 tons of gold ore daily, using fifty stamps.

Authorize Appointment of More Consultants to Bureau

APPOINTMENT of fifty more consulting engineers has been authorized by the U. S. Bureau of Mines. Formerly the limit on such appointments was 100. It was raised to 150 so as to secure a broader range of papers on mining, milling, and metallurgical subjects. Director Scott Turner expresses himself as being much gratified by the willingness of operating officials to co-operate with the Bureau in making an intimate study of costs within the industry. Some of the papers now being prepared deal with prospecting methods and methods of sampling and estimating ore in mines. Another set of papers will deal with the methods and costs of transportation to and from outlying districts. Transportation by pack train, canoe, truck, and airplane will be covered.

The Bureau is well advanced in its study of milling methods and costs. It expects next to take up cost studies in the metallurgical branch of the industry.

Under the new policy, consulting engineers are appointed for a term of one year and will not be reappointed. In this way the burden of this volunteer work can be placed upon more shoulders and advantage can be had of views from a broader group of mining men.

■

Test Selective Flotation for Butte Lead-Zinc-Manganese Ore

Metallurgists of Anaconda Copper Mining are now testing the possibilities of applying selective flotation to the complex ore produced from the Emma mine of Butte Copper & Zinc, in the Butte district, Montana. For several years the company, which is controlled by Anaconda, has been mining two classes of ore. One class contains a good grade of lead-zinc sulphide, carrying silver with rhodochrosite and quartz gangue. This ore is shipped to the Anaconda flotation plant, where the sulphides are recovered and the manganese in the rhodochrosite is lost. The other class of ore, containing high-grade rhodochrosite, is shipped to the Domestic Manganese & Development plant at Butte, where it is roasted and a product assaying 56 per cent manganese and less than 15 per cent silica is obtained.

If the present tests are successful only one class of ore will be mined, and that will be shipped to the Anaconda flotation plant, where both the sulphides and the rhodochrosite will be recovered by selective flotation. A much higher-grade product is expected from roasting the flotation concentrate at the manganese plant than is possible at present by treating the crude rhodochrosite.

■

No Results Yet in Exploring Keweenaw County Ground

Although results on the whole have not been encouraging, as far as finding of copper deposits is concerned, Calumet & Hecla will continue exploration on its Keweenaw County properties, in Michigan, during 1930. This is the third year of the work. The territory, either owned or under option, is extensive, and crosscutting and drifting in the old Cliff and Phoenix shafts are being supplemented by diamond drilling. Drilling along the eastern sandstone, south of the old Central mine, will be continued, so that a thorough study may be made of the formation. Drilling has also been done between the Phoenix and Central properties. In the Cliff and Phoenix properties occasional seams have been followed without result.

■

Denver Association Meets

Greater activity was manifest in Colorado's mining camps during 1929 than has been noted for a long time, according to the general consensus of opinion at the annual convention of the Denver County Mining Association at Denver, Colo., on Dec. 27. The association passed a resolution condemning the proposal to dismantle the Colorado & Southern Railroad between Denver and Leadville. George Collins was appointed chairman of a committee to represent the association in the matter.

■

Sidney Strikes New Oreshoot

Crosscutting west of the shaft on the No. 7 level of the Sidney mine, in the Coeur d'Alene district of Idaho, has struck a new lead-zinc oreshoot, 3 ft. 6 in. wide, according to C. W. Brown, manager of Sidney Leasing. The original Sidney orebody has been proved for a length of 700 ft., the No. 7 level being the deepest in the mine to date. The shaft is now being continued to the No. 8 level. Production is at the rate of about 150 tons of ore daily, assaying about 7 per cent lead and 14 per cent zinc.

■

Pecos Cuts Output in Half

Operations at the Pecos zinc-lead mine of American Metal, near Santa Fe, N. M., were reduced to 50 per cent of capacity, effective Jan. 1. Capacity is 600 tons daily. The cut was made because of the condition of the zinc market. Development work is being continued without curtailment, however, and only a small number of men will be laid off.

Drilling has demonstrated that the new Cucaracha orebody continues to the elevation of the No. 13 level. This orebody, discovered by drilling south of the mine in the Evangeline shear zone, had previously been proved only to the elevation of the No. 11 level. Development on the No. 8 level, the deepest operating level in the mine, continues favorable.

■

Tom Reed Shaft at 1,000 Ft.

Sinking of the Tom Reed shaft, at Oatman, Ariz., has reached 1,000 ft. The objective is 1,500 ft. Water has been pumped out of the winze through which the recent strike was made on the 950 level, and stopes are being prepared at that depth. Milling was suspended for two days during Christmas, but has been resumed and operations are now at the rate of 100 tons daily. Two shipments of bullion have been made since the plant was started in November, the second being of 1,800 oz. of gold.

Resumption of pumping at Tom Reed has reduced the amount of water at the United American, and shaft-sinking has been continued at that property. From the 1,000 level, which is the same elevation as the Tom Reed 950 level, drifts will be driven toward the Tom Reed orebody.

Van Dyke Copper Plans Increase in Output and Development

SEVERAL improvements are being made on the Van Dyke Copper property, at Miami, Ariz., to facilitate development and production. The output of the property will be raised to 4,000 tons monthly when the new equipment is ready. Plans are also being made to sink a second shaft. The property is now making weekly shipments of about five carloads of carbonate ore, averaging 6 per cent copper. Shipments are sent both to the International Smelter, at Inspiration, and to the Phelps Dodge smelter, at Douglas.

The crosscut from the shaft to prove the ore encountered in No. 2 drill hole at a depth of 1,200 ft. has been driven 600 ft. of the total distance of 2,600 ft. Drifting and raising are being continued on the 1,200 and 1,300 levels by two shifts of 29 men each. The mine will soon be put on a twenty-hour basis, with a small split shift that will overlap the afternoon shift four hours.

New gears, made by the Bash Ross Tool Company, of Los Angeles, have been purchased for the 300-hp. Lidgerwood hoist. Hoisting speed will be reduced from 1,370 to 840 ft. per minute, but the load capacity will be increased one-third. Ore is now being hoisted in one-ton cars, but a three-ton skip will be installed as soon as ore pockets have been built at the shaft collar and on the 1,300 level. A new cage has also been ordered. Power cables are being placed in the shaft from surface to the 1,300 level. A new Fairbanks-Morse 100-g.p.m. duplex pump, operated by a 75-hp. Fairbanks-Morse motor, has just been installed on the bottom level and is being used to keep the mine free of water. The mine is not troubled with a severe water problem.

■

Install New Diesel at Ruby

Installation of a new 960-hp. Fairbanks-Morse Diesel has been completed at the Montana mill of Eagle-Picher Lead, Ruby, Ariz. The plant is working at capacity, treating 300 tons of lead ore daily. The labor force at this unit has been increased to 250 men.

■

Clinton-West Handling 400 Tons

Tonnage handled at the Clinton-West flotation plant, at Bodie, Calif., has been increased to 400 tons daily. Operation was started in November. The plant is re-treating material from the dumps of the Standard Consolidated mine, containing gold tailing. Scrapers are used in collecting the material at the screening plant.

■

Reopen Old Silverton Mines

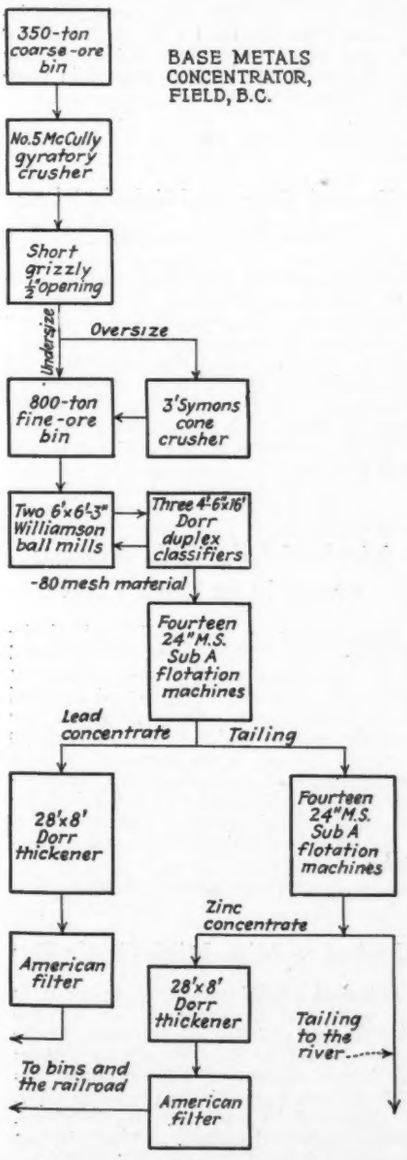
North Star-Sultan Mining has been formed to take over the North Star and Sultan properties, near Silverton, Colo. Warren Prosser, Denver mining engineer, is interested in the new company, which will have a capitalization of $1,000,000. The old North Star mill will be remodeled to handle 300 tons of copper-silver-gold ore. Reserves are stated to be 275,000 tons. Connections of the old working, from which about $8,000,000 has been produced, will be effected while mill remodeling is in process.

High Recovery Obtained From Complex Ore at Base Metals

RECOVERIES from the 300-ton flotation concentrator of Base Metals at Field, B. C., have been high, considering the complex character of the ore and the fact that the plant has been running only since the middle of November. On Jan. 2, George Wingfield, of Goldfield Consolidated, which controls Base Metals, stated that tailing loss averaged about 0.9 per cent lead and 1.2 per cent zinc of a total metal content of the mill heads of from 16 to 17 per cent, divided about equally between the two metals. Heads will later be stepped up to 26 per cent metal content, which is about the average grade of the ore. About five carloads of concentrate are being shipped regularly. Lead concentrate averages 72 per cent lead and zinc concentrate about 52 per cent zinc.

Operations are now at capacity, with the possibility of increasing tonnage to 350 tons daily. Later additional units may be added that will bring capacity up to 1,000 tons daily. Early in December, the extremely cold weather threatened to freeze the concentrate, but otherwise no difficulties have been encountered in operation.

At the mine, where about 400,000 tons of ore has been proved, development continues satisfactory. On Dec. 14 the West Monarch orebody had been proved for 850 ft. in length, 120 ft. in width, and 23 ft. in thickness, with the face still in ore. All ore is handled through a main haulage tunnel and fed into a 600-ton ore pocket, whence it is conveyed to the mill by a Riblet cable tramway, with a 1,700-ft. span. The mill flow sheet is shown herewith.



Falconbridge Hole Cuts Ore at Depth of 1,500 Ft.

Drilling has encountered ore at a vertical depth of 1,500 ft. at the Falconbridge Nickel mine, Sudbury, Ont., thus proving the continuation of the orebody at that depth. The first hole was started about 300 ft. north of the shaft in the hanging wall at the 1,000 level and entered the orebody at a 55-deg. angle at about 475 ft. The hole intersected a total of 40 ft. of mineralization, comprising two sections of ore about 14 ft. wide separated by 12 ft. of junore. True ore width at this depth is calculated at about 21 ft., which compares favorably with 20 ft. at the 1,000 level. Official assays, after eliminating 44 per cent waste, averaged 2.58 per cent nickel and 1.38 per cent copper.

The second deep hole, which was started from the same position but at an angle of about 70 deg., is expected to reach its objective at about 2,000 ft. from the surface. A third hole will be put down to explore the contact at 3,000 ft. The second hole is now down about 700 ft.

Preliminary reports that the Falconbridge smelter had started operation of some of its units were premature. About a month more will be necessary before ore treatment is started and probably capacity operations will not be attained until some time in the spring. The plant is equipped to handle 250 tons daily, but it has been built so that this capacity can be raised to 500 tons.

■

Amulet Sinking Shaft for Mining "F" Orebody

Sinking of a new shaft to develop the "F" orebody at the Amulet Mines property, near Rouyn, Que., was started recently. The shaft will be put down to 370 ft. and two levels established at 255 and 355 ft. Drilling this summer and fall indicated the presence of 200,000 tons of copper-zinc ore in the "F" orebody, which is 400 ft. long and from 50 to 250 ft. wide.

In addition, drilling is being undertaken southeast of the "F" orebody to determine whether another orebody occurs south of the diabase dike above which "F" orebody occurs. One drill hole struck 6 in. of high-grade ore in this ground.

■

No New Shaft for Frood

Reports that International Nickel would sink a third large shaft at its Frood property have been denied by J. L. Agnew, vice-president in charge of the operations in the Sudbury district, Ontario. Ultimately additional shaft capacity will be needed, but the present outlets are sufficient to accommodate the work now planned. About 2,000 men are employed in the Frood mine now, most of them on development work between 2,000 and 2,800 ft. Ore shipments from development to the Coniston smelter are averaging 1,500 tons daily.

Las Dos Estrellas Fails to Develop New Reserves

NO RESERVES of importance have yet been developed in the work of opening up old stopes in the Esperanza mine of Las Dos Estrellas, at Dos Estrellas, Michoacan, Mexico, according to H. E. Nyberg, general manager of the company. On Oct. 10, the Mexican federal government was notified that ore reserves were being depleted rapidly and that a shutdown was inevitable, barring the possibility of developing additional reserves in the old Esperanza property. Dos Estrellas is practically the last important producer left in the famous El Oro silver-gold district.

During 1929, according to Mr. Nyberg, about 770,000 short tons of ore was extracted, with an average assay value of 3 grams of gold and 112 grams of silver a ton. About 1.5 miles of development work was driven at various points in the old Esperanza mine during the year. For the first six months of the year the mine operated at a small profit, but during the last six months the losses and profits practically balanced, so that results have been far from satisfactory, although production was comparatively high and more than 3,000 men were employed.

The company, formed in 1898, has a capitalization of 300,000 pesos. Operations are conducted through ten shafts and seven adits. Electric power is purchased, but the company also has a 1,500-kw. steam-electric plant in reserve. The milling and cyanidation plant has a capacity of 2,500 tons daily, and includes a Merrill zinc-dust precipitation unit with the Crowe vacuum process.

■

Ontario Refinery to Be Completed This Summer

Construction of the new Ontario Refining copper refinery, at Copper Cliff, Ont., has progressed rapidly, and the plant will probably be complete this summer, according to reports from official sources. Work on the plant was not started until the summer of 1929. The speed of its construction will probably constitute a record for installations of similar size. It is equipped to handle 120,000 tons of copper annually. The new Frood smelter of International Nickel, also under construction at present, will not be completed as soon as the refinery, but it is expected to be in operation some time in the fall of the year. The smelter will provide most of the blister for the refinery, which is controlled by International Nickel, American Metal, and Consolidated Mining & Smelting.

■

International Congress at Liége

The sixth session of the International Congress of Mining, Metallurgy, and Applied Geology will be held at Liége, Belgium, on June 22-28, 1930, during the International Exhibition there. M. Fourmarier, professor at the University of Liége, is the chairman of the general organization committee. The Congress has been arranged by the Liége Association of Engineers and the Geological Society of Belgium in consultation with the societies which took part in the conference at Dusseldorf in 1910. Further details may be obtained from the secretary of the organization committee, 16, Quai des Etats-Unis, Liége, Belgium.

Gold Supply Is Insufficient for Needs, Fisher Declares

Business prosperity is definitely threatened by a gold shortage, which may occur within three years, Professor Irving Fisher, of Yale University, testified on Jan. 6 before the legislative commission for revision of the public service law in session at the headquarters of the Bar Association in New York City.

Unless some form of international control of gold and its production is put into effect, Dr. Fisher declared, the trend toward a lack of sufficient gold for the world's economic needs will continue and will suddenly reach a crisis attended by insufficient credit and collapse of commodity prices.

Dr. Fisher predicted that the present cheapness of gold, or, conversely expressed, high prices of commodities, would breed a shortage of gold. He pointed out that in 1920 gold had one-half the buying power it had before the war, and that today it has two-thirds of the pre-war buying power. Even that slight increase in the last decade, he said, was only temporary. This low price of gold, Dr. Fisher said, had discouraged gold mining. Consequently the increase in the amount of gold in circulation has slowed up to a marked extent, while the increase of all commodities has continued at a far greater rate. Eventually this process will result in a shortage of gold reserve, he declared, and when this reserve drops to a certain point it will automatically shut off further credit expansion, thus squeezing business and precipitating hard times.

■

New Orebody Hit in Crosscut at New Guinea Goldfields

A radio report from the property of New Guinea Goldfields near Wau, New Guinea, states that a new orebody has been intersected in a crosscut from the shaft at location No. 14. The width at the time the report was made, Dec. 19, was 20 ft., with an average value of 40s. per ton. Recently all work on this location was resampled and checked. The average gives assays of 101s. 3d. over a width of 98 ft. and a length of 394 ft. All faces of drifts to the west are still in high-grade ore. New Guinea Goldfields is controlled by Mining Trust.

■

Mexico Grants President Right to Alter Mining Code

On Dec. 27, the Mexican Congress authorized the president of the republic to issue a decree at his convenience putting the new mining law into effect. The proposed law has been in the hands of government officials for some time, but presumably it will be submitted to representatives of the mining interests before it is finally declared to be in force. As much of it as is known is said to be favorable to mining interests in general.

On the same day the new mining tax law went into effect. Among other points it provides for a decrease of 1 per cent in the tax on silver production, and slight decreases in zinc and lead taxes. Copper taxes, on the other hand, have been increased. The new law also removes the separate collection by individual states formerly in force. All taxes will be paid to the federal government at the national bank, Mexico City, and the states' portions will be distributed by federal authorities.

■

X-Ray Laboratory Installed at Salt Lake Station

An X-ray laboratory to supplement microscopic work of investigating the crystal structure of minerals and intermediate metallurgical products, to further improvement of ore dressing and metallurgical processes, has been added to the Salt Lake City microscopic laboratory of the U. S. Bureau of Mines and the University of Utah. All work will be done in co-operation with the Bureau of Mines, with Dr. Dorsey A. Lyon as supervising engineer. R. E. Head, chief microscopist and acting senior investigator, with J. Koster, formerly with the Western Electric Company in Chicago, have been assigned to conduct the experimental work.

■

Howey Gold Mill to Start Late This Month

Operations will be started at the new milling and cyanidation plant of Howey Gold, in the Red Lake district, northwestern Ontario, late in January, according to J. E. Hammell, president of the company. Construction of the Ontario government's hydro-electric plant at Ear Falls and of the transmission line to the mine has been completed. The mill will start handling 250 tons daily, being gradually stepped up to 650 or 700 tons a day. Average grade is $7. Only additional cyanide tanks will be needed to increase capacity to 1,000 tons daily.

Development shows that width of the ore continues to increase with depth. On the 625 level, drifting shows a length of 600 ft. of ore, averaging 15 ft. in width. On the 1,000 level, 400 ft. of ore has been drifted in, with a width of from 35 to 40 ft. indicated.

■

Poderosa Shipping Lower Grade

Because of the higher price of copper now obtaining, Poderosa Mining, operating claims in the Collahuasi district, province of Tarapaca, Chile, has been able to ship lower grade ore than heretofore. Estimates place total shipments for 1929 at 13,950 tons of ore assaying 18.5 per cent copper, as compared with 12,515 tons of an average grade of 21.3 per cent copper shipped in 1928.

■

North Butte to Diamond Drill

Diamond drilling east of the Continental fault on the 2,200 level of the Main Range mine will be started immediately by North Butte Mining, at Butte, Mont. High-grade copper ore was found east of the fault on the 2,000 level several years ago, but water made operations impossible. Pumps have now been installed and a 200,000-gal. sump has been provided to prevent a recurrence of flooding. Excess water will be drained out through the drill holes. Production from the Granite Mountain property in December was 9,000 tons of ore, the largest since the mine was reopened. A further increase is expected in January.

Estimate 10 Per Cent Increase in Canada's 1929 Output

For the fourth year in succession, Canadian mining reached a new high record in the value of its output in 1929. S. J. Cook, of the Dominion Bureau of Statistics, puts the total value of the output last year at $303,876,000, or 10.5 per cent more than in 1928. New records were established in copper, gold, nickel, zinc, and asbestos production. Metals as a group are estimated at $151,327,000, compared with $132,012,454 in 1928.

Of the copper production of 242,401,000 lb., British Columbia produced about 103,000,000 lb., Ontario about 84,000,000 lb., and Quebec about 55,000,000 lb. International Nickel accounts for nearly all Ontario's output and Noranda Mines for nearly all of Quebec's. Gold production was put at $39,585,000, most of which came from Ontario. An item of interest in the gold figures is the order of the principal producers. Hollinger led, followed by Lake Shore, Teck-Hughes, McIntyre Porcupine, Dome, Premier, Wright-Hargreaves, and Noranda.

Lead production declined slightly in quantity, from 337,946,688 lb. to 327,062,151 lb., but its value increased because of the higher price in 1929. Zinc production increased from 184,647,374 lb. to 204,621,300 lb., and silver output showed a small gain to 22,368,000 oz. Silver dropped in value as a result of lower prices.

■

Formal Start of Nichols Plant Takes Place on Jan. 28

Formal opening of the new Nichols Copper refinery, at El Paso, Tex., will take place on Jan. 28, although the electrolytic department of the plant is already in operation. E. H. Robie has described the installation in an article on p. 6 of this issue. The plant will employ between 400 and 500 men, with an annual payroll of $500,000, exclusive of salaries of company officials.

■

Kirkland Lake Gold Reaches Orebody on 3,875 Level

Crosscutting on the 3,875 level of the Kirkland Lake Gold mine, at Kirkland Lake, Ont., has reached the orebody at that depth. It is 4 ft. wide and reported to be high grade. Crosscutting to the orebody is also under way on the 4,000 level, the deepest in the mine and, in fact, in any Kirkland Lake property. The orebody on the 3,875 level was cut before the management had expected, indicating that it is longer at this depth than on the levels above.

■

Newbec to Mine High-Grade Ore

Shipment of high-grade copper ore from the small orebody developed on the 125 and 250 levels of the Newbec mine, in the Rouyn district of Quebec, will start about the first of February. About 10,000 tons of 7 per cent copper is said to be in sight. A winze will be sunk from the 250 level, 390 ft. east of the shaft, and will be put down to 375 ft.

Rainfall Averts Broken Hill Shutdown; New Ore Found

A HEAVY thunderstorm in the Broken Hill silver-lead-zinc district, New South Wales, Australia, has averted a possible suspension of operations. As the rainfall in the district during 1928 was only 4.28 in., the requirements of the town of 26,000 people and the mines drew heavily on the two reservoirs at Stephens Creek and Umberumberka. A suspension this month appeared imminent, but the water supply is now stated to be sufficient for twelve months.

Efforts are being made to determine whether the main Broken Hill ore channel extends north beyond the De Bavay fault. A shaft sunk half a mile from the fault, together with drilling, has indicated a high-grade sulphide orebody, 40 ft. wide, at a depth of 70 ft. from the surface. The orebody is below the water level, which is taken to explain the presence of sulphide ore near the surface. Further drilling is being undertaken.

The number of men employed in the district is increasing as a result of the reopening of the Broken Hill Proprietary and Block 14 mines. At the end of October 5,112 men were employed in the district, an increase of 293 over the figures for September.

■

Penrose to Head G.S.A.

Dr. R. A. F. Penrose, of Philadelphia, was elected president of the Geological Society of America, succeeding Prof. Heinrich Ries, of Cornell University, at the forty-second annual meeting held Dec. 26-28, in Washington. Dr. Penrose is a prominent consultant in mining geology. After graduation from Harvard University he took part in the Arkansas geological survey in 1890, and published a report on the manganese deposits of the state.

The meeting was very well attended, 500 members and their guests being present at the dinner following the sessions on Dec. 27. A unique feature of the evening's entertainment was a series of humorous geological skits staged by members of the U. S. Geological Survey.

Next year's meeting will be held at Toronto. The dates will probably be Dec. 22-24.

■

Colorado Men Meet This Month

The seventeenth annual meeting of the Colorado Mining Association and the thirteenth annual meeting of the Colorado chapter of the American Mining Congress will be held jointly in Denver on Jan. 21 and 22. The committee in charge is now making arrangements for the speakers and for the annual sowbelly dinner, which will be given on the evening of Jan. 21, at the Cosmopolitan Hotel. Regular sessions will be held in the auditorium of the Continental Oil Building.

■

Start Metalsmith Plant

Operation of the Empire mill of Metalsmith Mines, at Marysville, Mont., has been started, and the plant is now running on a three-shift basis, handling 100 tons of complex ore from the Bell Boy and Smithville mines. Additional units are planned if development comes up to expectations.

New Modderfontein Increasing Tons Per Man

Appreciable increase has been effected in the efficiency of machine drills used in stoping and development at New Modderfontein, on the Witwatersrand, Transvaal. The tendency toward employment of additional mechanical devices has led to a higher output per man employed in shoveling and tramming, as indicated in the following compilation, based on 100 as the output per man in the year ended June 30, 1925:

Year Ended	Efficiency
June 30, 1925	100
June 30, 1926	104
June 30, 1927	109
June 30, 1928	110
June 30, 1929	120
Four months ended Oct. 31, 1929	128

A. W. Rogers Coming to New York

A. W. Rogers, president of the Transvaal Chamber of Mines in 1928 and a director of Central Mining & Investment—otherwise known as the Corner House—will leave Johannesburg for New York within the near future. Mr. Rogers will supervise oil and other interests of Central Mining & Investment in North and South America. Before taking up his residence at Johannesburg, Mr. Rogers had been engaged in work concerning the company's oil interests. While in Johannesburg, Mr. Rogers has held the chairmanship of Rand Mines, New Modderfontein, Modder East, and Durban-Roodeport Deep, and directorships on most of the other Corner House companies at various times.

■

Missouri-Kansas Zinc Now in Hands of Receivers

C. Erb Wuensch, Joplin manager of the Missouri-Kansas Zinc Company, which controls four concentrators, one tailing mill, and leases on more than 600 acres of mineral land in the Waco section of the Tri-State district, has been appointed ancillary receiver of the concern. Several New York creditors asked for a receivership of the concern on Dec. 23, which was granted following the filing of involuntary proceedings. The Irving Trust Company, of New York, was appointed receiver.

Inability of the company to meet the $7.50 per ton sinking fund provided for in the funded debt program and the interest on the now outstanding $1,000,000 in 7 per cent bonds, and at the same time to pay local creditors for merchandise, is thought to have brought about the receivership. The company owes close to $100,000 in open accounts to creditors in the Tri-State district, but these have not yet taken any action. Local creditors are confident that if the properties are released from the payment of the sinking fund and interest charges an operating profit sufficient to pay the indebtedness can be made, even though the zinc prices do not materially advance.

The company was the sixth largest producer in the Tri-State district in 1929, with a production of more than 21,000 tons of zinc.

Gain in South Africa's Asbestos Output Expected

ASBESTOS production of the Union of South Africa and Rhodesia is increasing steadily, and further increases are anticipated. New deposits have been discovered in Southern Rhodesia, while important developments are taking place in the Barberton and Carolina areas of the Union. Absorption of Rhodesian & General Asbestos by Turner & Newall has attracted most interest, of course, involving as it does the transfer of the famous Shabanie mine. At Barberton, the new cable tramway connecting the Amianthus chrysotile mines with the main railroad to Lourenco Marques has recently been completed. An increased output from the property will result. Total production from the Union had a value of £422,752 for the first ten months of 1929, as compared with £399,550 in 1928 and £343,301 in 1927.

African Asbestos Trust, which holds the Farm Kalkkloof asbestos mine, district of Carolina, Transvaal, will probably have to undertake financing to obtain funds for completing equipment of its properties. W. F. H. Dudgeon, consulting engineer for the company, estimates that 206,000 tons has been made available for stoping and milling by the 13,800 ft. of development driven since the property was acquired in May, 1928. A small pilot plant has been built and a total of £58,054 had been spent to June 30 in developing and equipping the mine. The property was purchased for £350,000.

■

Kepong Remodeling Dredge

Kepong Dredging has found that the dredge on its ground near Kuala Lumpur, Selangor, Federated Malay States, is too inelastic to cope with the varying conditions of the ground treated. After consultation between F. W. Payne, designer of the dredge, which started work in June, 1928, and G. W. Simms, general manager, alterations are being made that are expected to bring capacity up to 100,000 cu.yd. monthly. The chief trouble was found in maintaining treatment capacity up to digging capacity.

■

Rate Hearing on Metals

The next hearing on the Interstate Commerce Commission's investigation of the rail rate structure on non-ferrous metals, comprising Part 12 of the general investigation of rates under the Hoch-Smith resolution, will be held on Jan. 27 in Washington. At this hearing shippers will be given an opportunity to cross-examine railroad witnesses upon the testimony and exhibits submitted by them at the hearings Dec. 11-18 in Chicago. Following cross-examination of witnesses for the carriers, the commission will receive such evidence as the shippers desire to present.

■

Hecla Mill at Union Starts

Operation of the 125-ton concentrator built by Hecla Mining at the Union mine, north of Grand Forks, B. C., was started on Dec. 28, after a trial run of two days earlier in the week. W. L. Zeigler, superintendent of the Hecla mill, designed the plant, which treats a gold ore by flotation. Construction was started last summer.

CABLES

EXCLUSIVE TO "ENGINEERING AND MINING JOURNAL" AND "ENGINEERING AND MINING WORLD"
FROM CORRESPONDENTS IN THE PRINCIPAL MINING CENTERS ABROAD

Expect 200,000,000 Tons at N'Kana; Progress at Roan

London, Dec. 31, 1929. — Drilling at N'Kana, Bwana M'Kubwa's principal property in Northern Rhodesia, is now being conducted over a total length of 8 miles, including the recently discovered Mindola section. Boreholes to extend this length and to fill in the gaps are finding good ore. Estimates place the tonnage in sight at 100,000,000 tons of 4 per cent copper ore, with double this total expected. The company's last official estimate was 42,000,000 tons, but the Mindola discovery has greatly altered the situation since then. Materials for the pilot plant that will be built at N'Kana are piled at the Kafue River awaiting the early completion of the railroad bridge.

. . . . A steam shovel is now in operation at Roan Antelope, hastening the work of excavating foundations for the plants. A total of 3,395 natives is now employed at the property, a substantial increase over the total employed a half year ago. Some steel work is being erected and machinery installed. Rapid progress is being made.

. . . . Thirteen drills are in operation at N'Changa Copper and the adjoining area held by Rhodesian Congo Border Concession. Several of these are now nearing the ore horizon, and results are awaited eagerly. Mufulira, Rhodesian Selection Trust's subsidiary, is erecting a 1,250-kw. boiler and pouring foundations for the compressor plant and a turbo-alternator set. The deepest of the three Mufulira shafts has reached 553 ft.

. . . . The manager of Rhodesian Selection Trust, which holds the N'Kana concession, considers the area in which two new discoveries have been made as highly promising. A broken borehole cut 90 ft. of good sulphide below a depth of 717 ft., with zinc silicate both at the top and bottom.

. . . . Luiri Gold's reconstructed mill at the Matala Hill property is ready to start. This plant, with a capacity of 50 tons daily, started last January and operated intermittently until July, when it was closed for alterations.

■

Soldado Mill to Start in April; Disputada Increasing Capacity

Santiago, Chile, Dec. 28, 1929.—The 500-ton flotation plant being built at Soldado by Compagnie Minière du M'Zaita will start operations in April, according to the present progress of construction work. Concentrate will be smelted at Chagres, where 1,000,000 pesos is being spent in enlarging the converter section. M'Zaita acquired control of the entire Chagres properties last spring and has been producing at the rate of about 3,000 tons of copper annually since then. Enlarging of capacity will provide for an output of from 8,000 to 10,000 tons.

. . . . Disputada, operating in the Las Condes district, is adding another section to its mill, bringing the total treatment capacity from about 350 tons daily to more than 500 tons. The cable tramway connecting the mill with the mine is being strengthened to carry the greater load. Production is now on the basis of 20,000 tons of 21 per cent concentrate annually.

. . . . The Guayacan smelter, in Coquimbo, which has been financed by the Caja de Crédito Minero, is actively buying copper ores to form a stock previous to blowing-in the furnace. Tocopilla Mining has purchased the Panulcillo mines from the Banco Anglo for 500,000 pesos. About 700,000 pesos will be spent in development. Copper mining activity throughout Chile is fair on account of the better price and the aid extended by the national mining bank, Caja de Crédito Minero.

■

New Kansanshi Find High Grade; Wheeler Appointed Metallurgist

London, Jan. 2, 1930.—A progress report has just been issued on the Kansanshi mine of Rhodesia-Katanga. It states that three drives on the new dolomite deposit reveal an average of 14.6 per cent copper. All the drives are still in ore. Reef "A" shows 2 per cent copper and 5.25 dwt. in gold per ton over a width of 57 in. for 175 ft.

. . . . A. E. Wheeler, consulting metallurgist, of New York, has been retained by Rhodesia-Katanga to determine plant construction for Kansanshi. A small smelter was operated on the property prior to 1914.

■

Labor Force Cut on Central Rand; Nickel in Southern Rhodesia

Johannesburg, Dec. 24, 1929.—Considerable retrenchment of the number of European miners on the Central Rand section of the Witwatersrand has followed a serious shortage in colored labor. City Deep, which has been incurring heavy losses in recent months, and Village Deep, which is being absorbed by Robinson Deep, are particularly affected. These two mines are the deepest on the Rand, and consequently costs are comparatively high.

. . . . The Transvaal Chamber of Mines is making representations to the government concerning the growing burden of compensation for miners' phthisis. Payments made by Rand mining companies in this connection have been averaging about £1,000,000 annually, or about 2.5 per cent of the gross value of the output.

. . . . Highly encouraging results have been announced on the Rhodesian Nickel Corporation's properties in the Gwanda district, near Bulawayo, Southern Rhodesia. At the annual meeting of De Beers Consolidated in Kimberley on Dec. 20, profits of more than £2,000,000 for the year ended June 30, 1929, were reported.

German Metal Consumption Off; May Put Duty on Aluminum

Berlin, Dec. 28, 1929.—German metal consumption in 1929 was about 15 per cent less than in 1928, according to estimates. Imports of copper during the eleven months ended November were 185,193 metric tons, compared with 211,432 metric tons in the same period of 1928. The outlook continues gloomy. The value of imported copper ores in 1929 will be about 33,000,000 marks. Mansfeld, the principal German producing mine, had an output of about 865,000 tons of ore, so that German production of primary copper will show an increase of about 11 per cent in 1929. Mansfeld's copper output is estimated at 22,000 tons.

. . . Duties of 250 marks per ton of aluminum imported are expected to be levied early in January. This step is being taken as a protection against alleged dumping of output by the Aluminum Company of America. Large stocks held by consumers are expected to be guarantees that the price will not be greatly influenced by the duty.

. . . The official valuation of the total output of base metals in 1928 is put at 464,000,000 marks, of which copper accounts for 157,000,000 marks, lead for 53,000,000 marks, zinc for 54,000,000 marks, and aluminum and nickel for 72,000,000 marks.

■

London Tin Syndicate Makes Offer for Other Companies

London, Dec. 27, 1929.—Proposals have been made to merge English tin-mining interests with a total capital of £2,250,000. London Tin Syndicate will form the nucleus of the new group. Share exchange terms are seven shares of London Tin for sixteen shares of Tin Selection Trust, three London Tin shares for eight London-Malayan Tin Trust shares, one London Tin share for six Mongu Tin shares plus a dividend of 9d per share, and one London Tin for sixteen Anglo-Bauchi Tin Dredging. The new capital will be equally divided between non-cumulative 8 per cent preferred shares with a par value of 10s. and ordinary 10s. shares. London Tin Syndicate, which will be the largest tin producer in the British Empire, has also acquired Northern Nigeria Tin, and Ropp Tin during the last year.

. . . . John Howeson, chairman of Anglo-Oriental Mining Corporation, has joined the board of the new company. New Consolidated Goldfields is represented largely by Lord Brabourne and O. V. Hoare. The fusion has been undertaken for the purpose of simplified production and control, and for the economies which are expected to result from pooling interests and resources. The moderate capitalization reflects the abnormal condition existing in the tin industry. Prospects for 1930 consumption are considered good, with an estimate of world deliveries put at 135,000

tons of tin. The new company controls the bulk of Nigerian production and has a large stake in Eastern tin dredging. With the merger of four smelting companies into a £5,000,000 organization, the tin industry is apparently succumbing to the modern urge for consolidation.

. . . . De Beers Consolidated Diamond Mines and New Jagersfontein are taking similar steps in the diamond industry. These companies are subscribing 50 per cent of the capital of a new company formed to hold surplus diamond production, thus protecting the industry and giving confidence to it.

. . . . Non-Ferrous Metal Products, Ltd., has been formed with a capital of £100,000 in £1 shares to promote the consumption of zinc, copper and lead. The new company has borrowing powers of £1,000,000.

. . . . At the annual meeting of the Sulphide Corporation, which operates the Central mine, in the Broken Hill district, the Earl of Kintore, chairman, said that co-operative action of the leading zinc smelters was proving successful in attempts to arrange reduction of output and to maintain the price at a more profitable figure.

Trepca Mines Building Mill at the Stantrg Mine

Construction of a 500-ton concentrator at the Stantrg mine, in the Trepca Concession, Jugoslavia, held by Trepca Mines, Ltd., will be completed and production will start about next September. The property carries silver-lead-zinc ore, estimates made in July putting the total at 1,750,000 tons of 11.5 per cent lead, 10.5 per cent zinc, and 3 oz. of silver to the ton. Diamond drilling has indicated a large tonnage of ore below the 760-m. level, the lowest on which the orebody has yet been opened. The company has acquired prospecting rights to the Slatinska and Sololica concessions. Selection Trust controls Trepca Mines.

■

Burma Corporation Discovers Old Chinese Mine Workings

Discovery of extensive Chinese workings on No. 2 level, south of the Hswenwi fault, was announced by Sir R. S. Horne, chairman of the Burma Corporation, at the annual meeting on Dec. 20 in Rangoon. The find is a result of the program of exploration started last year at the company's Bawdwin silver-lead-zinc mines. Development is being continued vigorously on Nos. 4 and 6 levels to locate the downward continuation of the lode. The most recent crosscut to find ore was driven 878 ft. north of the shaft on Shan Lode No. 8 level, and cut 5 ft. assaying 15 per cent lead, 4.6 per cent zinc, 1.4 per cent copper, and 11 oz. of silver to the ton.

■

Mawchi to Start in March

Mawchi Mines will resume production from its properties in the State of Bawlake, Burma, India, in March on the basis of 4,000 tons of wolfram-tin ore a month. Installation of a second power plant will probably be concluded by next June and capacity will then be stepped up to 6,000 tons a month. The mine has not been producing since August, 1927. Latest development news is that vein No. 23 has been struck on the lower level and is 3 ft. wide.

Will Build Fireproof Plant at Levack Mine Shaft

Construction of a fireproof surface plant at the Levack mine of International Nickel, Sudbury, Ont., will be started as soon as the mass of wreckage from the fire on Dec. 15 has been removed. A new headframe, crusher plant, and transformer building will be erected. Loss in machinery from the fire included two large Hadfield jaw crushers, a Symons cone crusher, Telsmith crusher, ore trommels, magnetic ore-separating equipment, ore bins, and screens. Part of the electrical equipment in the transformer house was destroyed, but the transformers will probably be reclaimed. The fire evidently started in the motor operating the Symons cone crusher. A temporary headframe may be constructed to permit continuing development below No. 8 level while the permanent unit is being erected.

■

Howe Sound Drops Kootenay King; New Cars at Britannia

Howe Sound has dropped its option on the Kootenay King property, at Victoria Gulch, in the Fort Steele division, British Columbia, after spending $75,000 on development. The option was taken late in 1928, but exploration during the last year failed to fulfill the promise of surface indications of silver-lead-zinc ore. Kootenay King Mining, which owns the property, will continue development next year in the hope of proving sufficient ore to justify construction of a small mill.

At its Britannia property, Howe Sound has recently installed 20-ton gable-bottom cars manufactured by the Vancouver Iron Works to facilitate transportation of ore. The ore is dumped through a vertical raise to the primary crushers from the haulage tunnel.

Torbrit Mines is the name of the company formed to continue development of the Toric mine, in the Alice Arm district, on which Britannia also holds an option. About 50 men will be employed this winter. Decision as to whether the option will be exercised will be made in the spring.

■

C.M.&S. Development Plans; Pays Higher Bonus

With the arrival of the winter season, Consolidated Mining & Smelting has made several important announcements in regard to its development plans for British Columbia properties. The company has relinquished its option on the Caledonia group, near Port Hardy, Vancouver Island, and has suspended development for the season at the Hailstorm group, in the Arrow Lakes district. About 20 men were employed there this season, developing a silver-lead-zinc deposit at a depth of 350 ft. by tunnel. The company is negotiating for an option on the Smuggler Hill group, in the Ainsworth district, where a strong vein of silver-lead-zinc ore has been traced at elevations of between 7,000 and 8,000 ft. Though surface development at the Iva Fern group, at Cultus Creek, Kootenay Lake, was encouraging, exploration in the tunnel, where about 600 ft. of drifting was done on the vein, was the reverse. Consolidated has now started sinking on the vein from the tunnel, and sixteen men will be employed on this work during the winter.

Consolidated has increased the bonus given to employees at the end of the year, to compensate for the slightly lower wage rate resulting from lower zinc quotations. All married employees received a turkey at Christmas and the single ones an order for $3 worth of merchandise at the company's stores. On Dec. 27 all married employees with six months' or more continuous service to their credit were given $75 and single men of like record $37.50. This is an increase of 50 per cent over the bonuses given at the end of 1928.

■

Proposed Mexican Labor Law Fails to Pass

As was expected, the Mexican Congress adjourned in Mexico City on Dec. 31 without having passed the proposed labor law that caused so much discussion in the early autumn Only about one-tenth of the total number of articles contained in the code were discussed in the lower house. Possibly a special session may be called to consider the proposal, but the general opinion is that an entirely revised code will be submitted after the new president, Ortiz Rubio, is inaugurated in February. A general demand exists for labor legislation, but opposition to the current proposal has been extremely widespread.

■

Russia Buying Tin Ore for Smelting in Ukraine

Purchase of supplies of tin ore and concentrate from Bolivian mines by the Russian government for smelting at Nicolaev, Ukraine, is rumored. Boris Kravesky, president of the Soviet Luyamtorg, with headquarters in Buenos Aires, is now in La Paz endeavoring to make contracts for a two years' supply for the smelter. Organization of the smaller Bolivian producers into a group to supply the Russian plant is being attempted.

■

Mufulira Reserves Estimated

Twelve boreholes completed at the Mufulira mine, in Northern Rhodesia, have indicated 45,000,000 tons of ore averaging 4.68 per cent copper, according to A. Chester Beatty at the annual meeting of Rhodesian Selection Trust on Dec. 18. The mine will be equipped to produce 2,000,000 tons of ore annually, or about 75,000 short tons of copper. A borehole is now being sunk to test the site for the new vertical hoisting shaft. Preparation of the mine for production will be comparatively easy because of the great width of the orebody.

■

Wiluna Road Near Completion

Construction of the railroad to Wiluna Gold from Meekatharra, Western Australia, is practically complete. Work on the new 1,400-ton plant is progressing and should be completed by December, 1930. All orders for machinery have already been placed.

Recent improvements in the treatment process have necessitated certain alterations in mill design. All ore will be crushed to —200 mesh, and then put through flotation machines which will make about a 10:1 concentrate. The concentrate will be roasted in Edwards furnaces and cyanided.

MARKET AND FINANCIAL NEWS

International Asbestos Cartel—Tin Stabilization

W. A. Doman
Special London Correspondent

Full particulars on the Turner & Newall proposal to absorb the Rhodesian & General Asbestos Corporation are now available, and as amalgamation with Bells Asbestos had already taken place, the company will be one of the leading factors in the industry. Arrangements have been entered into with the principal manufacturers of ten European countries for an international cartel. The objects of the cartel are: the exchange of technical knowledge; the establishment in Switzerland of an institute of research for the entire industry; the foundation of new factories in neutral countries; organization of export business; standardization of quality and minimizing unnecessary variety in the product; and mutual assistance in securing the necessary raw materials on the best terms. European countries participating in the cartel are Great Britain, Czechoslovakia, Belgium, France, Holland, Austria, Italy, Hungary, Spain, Switzerland, and Germany. The Turner group will possess the major part of the superior grades of raw asbestos now produced in the world.

The price of tin has recovered smartly, owing to the fact that something is at last being done to assist the industry. When, some time ago, suggestions were cabled from London to the East, they did not meet with acceptance. As, however, the position in Malaya itself requires strengthening, the producers at Ipoh have got together and have reached an agreement on the lines of a definite stabilization policy. This was cabled to London. Further meetings have been held at Singapore and Kuala Lumpur, and cabled recommendations have been made also.

■

World Copper Production in November 170,585 Tons

Copper production of the world during November was 170,585 tons, which compares with 175,540 tons in the preceding month and 183,813 tons in November, 1928. The daily rate of production for November was 5,686 tons, against 5,663 tons in October and 6,561 tons in April, the peak.

Output of copper for the eleven months totaled 1,970,996 tons, against 1,916,471 tons for the whole of 1928 and 1,694,346 for the whole of 1927.

New York Metal Prices, Except Silver, Firm at Close of 1929

NO HEAVY BUYING of any of the non-ferrous metals was expected during the week intervening between Christmas and New Year's, and the market fully lived up to expectations. However, business was not entirely absent. Tin, for example, met a fair demand, and from consumers who wanted the metal for immediate consumptive needs. Copper, also, was sold in somewhat larger volume than in recent weeks, even though the total tonnage was not impressive; like tin, spot shipment was desired. Zinc and lead business fell off from the recent activity. Prices of copper, lead, and zinc were the same as a week before, and tin was also practically unchanged. Silver, however, was again rather weak, declining on Dec. 30 to the lowest price ever reached in the London market.

Better Feeling in Copper

Wire manufacturers were the chief interests represented in the copper market recently, and wire seems to be in a somewhat more favorable position than either sheet copper or brass. Orders are not yet coming in very actively, but it seems likely that December will show a somewhat better demand than existed in November. After the first of the year, business should continue to improve, in other lines as well, so that a good tonnage of copper should be sold during January.

Zinc Quiets Down

After two weeks of excellent zinc buying, apparently attributable to the very low levels at which the metal is now being offered, 5.45c. at East St. Louis, demand has been materially less, though practically all producers did a moderate amount of business. Specified delivery extended from prompt through March. Of chief interest has been the continued weak trend in London, which brought the price there down to £19 12s. 6d., the lowest level reached since before the war. No American producer, however, appeared to be willing to shade 5.45c.

Lead in Good Demand

Lead was not so active as earlier in the month, but the sales volume was satisfactory considering the time of the year. The tone of the market was quite firm. Prices were unchanged at 6.25c., New York, the contract quotation of the American Smelting & Refining Company, and 6.10c., St. Louis.

A feature in the market has been the good volume of contract business booked for 1930, indicating that consumers appear to have full confidence in the general situation. Contract business placed

To Users of "E. & M. J." Market Prices and Data

UNDER the publishing plan announced previously, the new semi-monthly *Engineering and Mining Journal* (which you are now reading) carries only a condensed review of important market news and price movements. For buyers and sellers of ores, metals, and minerals who require the latest information every week, we now publish every Wednesday night a new weekly—*E.&M.J. Metal and Mineral Markets.* Printed at high speed, mailed 48 hours earlier than heretofore, and in a new compact form for reference use, this new service has received enthusiastic indorsement from readers not requiring the technical contents and field operating news carried in the magazine. *Metal and Mineral Markets* is priced to subscribers in the United States and possessions at $2 yearly; to countries in the Americas, but outside the United States, $5; elsewhere, $10 per annum—52 issues.

Daily Prices of Metals

Dec. Jan.	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
26	17.775	39.875	6.25	6.10	5.45
27	17.775	39.375	6.25	6.10	5.45
28	17.775	39.375	6.25	6.10	5.45
30	17.775	39.25	6.25	6.10	5.45
31	17.775	39.75	6.25	6.10	5.45
1	Holiday	.....	....	....	....
	17.775	39.525	6.250	6.100	5.450

Average prices for calendar week ended December 28, 1929, are: Copper, 17.775c.; Straits tin, 39.600c.; New York lead, 6.250c.; St. Louis lead, 6.100c.; zinc, 5.455c.; and silver, 47.175c.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices of refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary forms of wirebars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight differential. Contract prices for High-Grade zinc delivered in the East are 1@1.15c., depending upon purity, above St. Louis prices for Prime Western.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a preminum is asked.

London

Dec. Jan.	Copper Standard Spot	Copper Standard 3M	Electrolytic	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
26	Holiday	....	....	....	....	....	....	....	....
27	67½	67¼	82½	177¼	180¾	21 11/16	21½	20	20⅜
30	67 3/16	66 13/16	82½	175⅛	178⅜	21 11/16	21½	19 13/16	20⅜
31	67⅛	67¼	83	178⅛	181⅜	21 11/16	21½	19⅞	20¼
1	Holiday	....	....	....	....	....	....	....	....

Prices for lead and zinc are the official prices for the morning session of the London Metal Exchange; prices for copper and tin are the official closing buyers' prices. All are in pounds sterling per long ton (2,240 lb.).

Silver, Gold, and Sterling Exchange

Dec.	Sterling Exchange "Checks"	Silver New York	Silver London	Gold London	Dec. Jan.	Sterling Exchange "Checks"	Silver New York	Silver London	Gold London
26	$4.87⅜	47⅛	Holiday	Holiday	30	$4.87½	46½	21 5/16	84s11½d
27	4.87 9/16	47⅛	21⅜	84s11½d	31	4.87 9/16	46¾	21 7/16	84s11½d
28	4.87½	46¾	21½	.....	1	Holiday	....	21⅜	84s11½d

Average: Silver, 46.900c.; Sterling Exchange, $4.875

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis of 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-fourths cent premium.

during December was even larger in tonnage than in the same month a year previous.

Cable manufacturers have been much in evidence as buyers of lead, the demand from this source being attributed to the trend toward the greater use of underground installations by the utility companies. Corroders have also been taking their regular requirements of the metal. Demand from battery makers has held up well, despite the depression in the automobile industry. Mixed-metal manufacturers have been taking a fair tonnage.

Tin Market Steady

The idea that tin is a buy below 40c. seems to be pretty well accepted in the trade, for prices refuse to drop much below that figure. The lowest recently was 39¼c., which was the quotation on Dec. 30 for spot Straits; the next day the price was up to 39¾c. Though some interests report a quiet market, others have experienced a reasonably active demand, especially for prompt shipment, indicating that consumers are bare of supplies and that the demand is likely to continue. Some interest has also been shown in futures, which have been sold at ⅜ to 7/16c. premiums, for three months. Supplies are fully adequate to take care of all inquiries for spot deliveries.

Silver Still Lower

The silver market continued its downward course until Dec. 30, touching a new low in London and within ¼c. of the lowest New York price on record. As a result of buying by India and moderate covering of short sales, the undertone appears slightly steadier at the close.

Mexican Dollars (old Mexican pesos): Dec. 26th, 35⅝c.; 27th, 35½c.; 28th, 35c.; 30th, 34¾c.; 31st, 35c.; Jan. 1st, holiday.

December a Quiet Month for the Steel Trade

Pittsburgh, Jan. 2, 1930

December was a dull month in steel buying, hardly comparing with November, but this was due largely or wholly to buyers all down the line to the ultimate consumer making a particularly strong effort to curtail stocks for Jan. 1 inventory. In the late days of the month demand increased noticeably in the majority of lines, in preparation for January activity.

Production of steel ingots in December was probably less than 60 per cent of capacity, and possibly not more than 50 per cent, against 69 per cent in November and 85 per cent in October. January will undoubtedly show a substantial gain over December.

Steel ingot production in 1929 totaled about 54,500,000 long tons, or an 8 to 9 per cent gain over 50,325,393 tons in 1928. The big performance, however, was the production of 56,750,000 tons in twelve months through September, a 21 per cent increase over 1926, the record year until 1928. A fair tonnage for 1930 would be slightly less than 50,000,000 tons, and that is all that is expected. Realized prices averaged about the same in 1929 as in 1928.

Pig Iron—The market has been quiet in all districts, the Valley market being practically stagnant, but with prices maintained, at $19 for bessemer and malleable and $18.50 for basic and foundry, f.o.b. Valley furnaces.

Connellsville Coke—Demand has been poor, resulting in some accumulation. Spot furnace is weak at $2.60@$2.65, against $2.65 formerly; standard grade foundry coke remains $3.75@$4.25.

Total Tri-State Shipments Greater than in 1928

Joplin, Mo., Jan. 2, 1930

Blende	Per Ton
High	$38.45
Premium blende, basis 60%	35.00
Prime Western, basis 60%	$34.00@35.00
Table concentrate, 60%	32.00@33.00
Flotation concentrate, 60%	31.00@32.00
Average settling price	35.94
Galena	
High	$77.80
Basis 80% lead	75.00
Average settling price	76.77

Shipments of zinc concentrate in 11,907; lead, 1,230 tons. Total value for the week, $522,440.

Shipments of zinc concentrate in 1929 were 18,492 tons in excess of the 1928 total; lead was smaller by some 600 tons. The value of total shipments of concentrate during 1929 was $3,633,270 greater than in 1928. Stock of zinc concentrate in the bins at the mines

is only 6,140 greater than a year ago. Zinc concentrate prices dropped from a basis price of $44, maintained from March to the end of October, to a high basis price of $35 at the close of the market last Saturday.

Shipments in 1929 by states follow:

	Tons zinc	Tons lead	Value both
Oklahoma.....	389,515	63,875	$22,274,810
Kansas.....	210,666	35,187	12,169,370
Missouri.....	12,361	1,441	613,790
Totals.....	612,542	100,503	$35,057,970

The two closing months presented a distressed appearance, with half of the mines of the district closed down, because of the low price level.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified. London prices are according to latest mail advices.

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c. London, 98 per cent, quoted at £95 per long ton, less 2 per cent for domestic consumption.

ANTIMONY—Per lb., duty paid: Chinese brands, spot, 8½c.; futures, 8⅛c. Good trade in spot and supplies firmly held despite easier position of futures. Cookson's "C" grade, spot, 14c. Chinese needle, lump, 8c. Standard powdered needle, 200 mesh, 10c.

BISMUTH—Per lb., in ton lots, $1.70. Smaller lots $1.85 and up. London 7s. 6d.

CADMIUM—Per lb., 80@90c. London, 3s.11d.@4s. for prompt.

CHROMIUM—Per lb., 97@98 per cent grade, 95c.@$1.

COBALT—Per lb., f.o.b. Canadian works: Shot or rondelles, 97@98 per cent, $2.50. Contract sales booked at discounts, depending on quantity. Black oxide, 70 per cent, $2.10. London, nominal, 10s. for metal in small lots, 8s. for black oxide; 8s. 10d. for gray.

GERMANIUM DIOXIDE—Per gram in 200- to 300-gram lots, $3.50.

IRIDIUM—Per oz., $210@$220 for 98 @99 per cent sponge and powder. London, £39@£42.

LITHIUM—Per oz., 98@99 per cent grade in 2- to 6-lb. lots, $6.

MAGNESIUM—Per lb., single orders for spot metal: 8-lb. ingots (3x3x15 or 16 in.), 95c.@$1.05, depending on quantity; 2½- or 3-lb. sticks (1⅛ in.) 90c.@$1.10, depending on quantity; 10-oz. sticks (1x12 in.), 80c.@90c. Discounts up to 20 per cent on larger orders or contracts. London 3s. 3d.@ 3s. 6d. for 99 per cent ingots or sticks.

MOLYBDENUM—Per lb. in 50- to 100-lb. lots, 99 per cent, $11. (Usually sold as calcium molybdate or ferromolybdenum.)

NICKEL—Per lb., ingot, 35c.; shot, 36c.; electrolytic, 35c. (99.90 per cent), for single lots of spot metal. London, per long ton, £170@£175. Demand is well sustained and quotations are steady.

OSMIUM—Per oz., $70; London, £13 15s.

PALLADIUM—Per oz., $35@$36; London, £6 10s.@£7.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $63. Transactions between dealers and refiners in the outside market are commonly reported at several dollars less.

London, per oz., £12 10s.@£13 for refined; crude and scrap, nominal at £11@£11 15s.

QUICKSILVER—Per 76-lb. flask, $121 @$122. Market quiet and prices on round lots nominal. San Francisco wires $126. London steady, with offers of near-by at £23.

RADIUM—Per mg. radium content, $70.

RHODIUM—Per oz., $50@$55. Nominal. London, £11@£12.

RUTHENIUM—Per oz., $42@$48. Nominal. London, £9 10s.

SELENIUM—Per lb. in 500-lb. lots; Black, powdered, amorphous, 99.5 per cent pure, $2. London, 7s. 8d.@ 7s. 9d.

TANTALUM—Per gram: Bar and heavy sheet, chemically pure, 16c.; tantalum powder, 11c.

TELLURIUM—Per oz., 15@18c.

THALLIUM METAL—$12.50@$15 per pound.

TITANIUM—Per lb., 80@90 per cent grade, $5.

TUNGSTEN POWDER—Containing 98 per cent tungsten, per lb., $1.70@$1.75.

VANADIUM—Per gram, 92@95 per cent grade, $1.20@$1.25.

Metallic Ores

ANTIMONY ORE—Bolivian ore, 60 per cent metallic antimony, $1.30 per short ton unit, c.i.f. New York.

CHROME ORE—Per long ton, f.o.b. Eastern shipping points, Indian and Rhodesian ores, $21.50 for 46@47 per cent Cr_2O_3 ore, and $24 for 50@51 per cent ore. New Caledonian ore, high-grade, $25.

IRON ORE—Per long ton, lower Lake ports. Lake Superior ores:

Mesabi, non-bessemer, 51½ per cent iron, $4.50. Old Range, non-bessemer, $4.65.

Mesabi, bessemer, 51½ per cent iron, $4.65. Old Range, bessemer, 51½ per cent, $4.80.

Eastern ores, cents per unit, delivered at furnaces: Foundry and basic, 56 to 63 per cent, 9c.

Foreign ores, f.o.b. cars Atlantic ports, cents per unit:

North African, low-phosphorus, 12½c.

Spanish and North African basic, 55@60 per cent, 11½@12c.

Swedish foundry or basic, 66@68 per cent, 10½c.

MANGANESE ORE—Per long-ton unit 8½@9c. Nominal.

Newfoundland foundry, 55 per cent, of Mn, c.i.f. North Atlantic ports. Exclusive of duty: Brazilian and Indian ores, minimum 47 per cent Mn, 31@34c. Caucasian, 53@55 per cent, 36c. Cuban, minimum 47 per cent, 35c. Chilean, minimum 47 per cent, 34c.

Per ton in carload lots:

Chemical grades, powdered, coarse or fine, 82@87 per cent MnO_2, Brazilian, Javan, Caucasian, and Cuban, $60@$65. Domestic, 70 to 72 per cent, $40@$50.

TANTALUM ORE—Per unit of Ta_2O_5, basis 60 per cent ore, $13.

TITANIUM ORE—Ilmenite, per gross ton, 50 per cent TiO_2, f.o.b. Atlantic seaboard, $9.50@$11, according to grade and impurities. Low-grade domestic, 32 to 35 per cent, about $7@$8 per gross ton. Rutile, per lb., guaranteed minimum 94 per cent concentrate, 10c. in carload lots.

TUNGSTEN ORE—Per short ton unit of WO_3, N. Y.: Wolframite, $15.50 for future delivery. Prices advanced 25c. a ton on increased buying interest; offerings from China light. Bolivian scheelite is quoted at $15.50, Jan.-Feb. shipment. Western scheelite, $16.50, with sales at this figure covering 1930 requirements.

VANADIUM ORE—Per lb. V_2O_5 contained, 28c.

ZIRCON ORE—Per net ton containing 55 per cent ZrO_2, f.o.b. Atlantic seaboard, $40@$45 in 30-ton lots.

Metallic Compounds

ANTIMONY OXIDE—White, Chinese, 99 per cent Sb_2O_3, 10½@11c. per lb. Nominal.

ARSENIOUS OXIDE (White arsenic)—Per lb., 4c., delivered, all positions. London, per long ton, £16 for Cornish white.

CALCIUM MOLYBDATE OR MOLYTE—Per lb. of contained Mo, 95c.

COPPER SULPHATE (Blue Vitriol)—Per lb. in car lots, 5½@6c. for either large or small crystals.

SODIUM NITRATE—Per 100 lb.; crude natural, in bags ex vessel, Atlantic ports, $2.14 for January deliveries.

SODIUM SULPHATE (Salt Cake)—Per ton, bags, f.o.b. works, $22@$23; in barrels, $25@$28.

Refractories

CHROME BRICK—Per net ton, f.o.b. shipping point, $45.

FIRECLAY BRICK—Per M.: First quality, $43@$46; second, $35@$38.

MAGNESITE—Brick, per net ton, f.o.b. works: 9-in. straights, $65, f.o.b. plant. Cement, $40, seaboard.

SILICA BRICK—Per M., $43@$52, f.o.b. shipping point.

ZIRKITE—Per lb.: Powdered, 65@70 per cent ZrO_2, 3½c. Brick, straights, 80c.@$1 each.

METAL STATISTICS

Monthly Average Prices of Metals

Silver

	New York		London Spot		Sterling Exchange	
	1928	1929	1928	1929	1928	1929
January	57.135	57.019	26.313	26.257	487.098	484.577
February	57.016	56.210	26.205	25.904	487.008	484.787
March	57.245	56.346	26.329	26.000	487.558	484.776
April	57.395	55.668	26.409	25.738	487.785	484.808
May	60.298	54.125	27.654	25.084	487.685	484.599
June	60.019	52.415	27.459	24.258	487.565	484.330
July	59.215	52.510	27.262	24.289	485.923	484.560
August	58.880	52.579	27.096	24.288	484.979	484.368
September	57.536	51.042	26.440	23.708	484.654	484.253
October	58.087	49.913	26.727	23.042	484.584	486.392
November	57.953	49.615	26.704	22.690	484.492	487.104
December	57.335	48.475	26.349	22.258	484.698	487.523
Year	58.176	52.993	26.746	24.460	486.169	485.173

New York quotations, cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York		London Spot			
	Electrolytic		Standard		Electrolytic	
	1928	1929	1928	1929	1928	1929
January	13.854	16.603	61.912	75.551	66.575	78.602
February	13.823	17.727	61.670	78.228	66.381	83.538
March	13.845	21.257	61.148	89.153	66.443	98.356
April	13.986	19.500	61.678	81.036	66.500	89.405
May	14.203	17.775	62.554	75.026	67.216	83.727
June	14.527	17.775	63.664	74.338	68.738	84.013
July	14.527	17.775	62.881	72.152	68.670	84.043
August	14.526	17.775	62.472	73.783	68.750	84.250
September	14.724	17.775	63.522	75.286	69.800	84.363
October	15.202	17.775	65.524	72.815	71.935	83.978
November	15.778	17.775	68.080	69.324	74.750	82.202
December	15.844	17.775	69.336	68.303	75.000	82.569
Year	14.570	18.107	63.703	75.416	69.230	84.921

New York quotations, cents per pound. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London			
	1928	1929	1928	1929	1928 Spot	1928 3 Mos.	1929 Spot	1929 3 Mos.
January	6.500	6.650	6.280	6.498	21.773	22.213	22.111	22.344
February	6.325	6.853	6.069	6.739	20.283	20.747	23.128	23.156
March	6.000	7.450	5.805	7.348	19.938	20.352	25.409	25.591
April	6.100	7.187	5.991	7.025	20.306	20.563	24.783	24.408
May	6.123	7.000	6.012	6.761	20.483	20.813	23.949	23.750
June	6.300	7.000	6.152	6.790	20.985	21.211	23.694	23.603
July	6.220	6.804	6.038	6.607	20.602	20.957	22.810	22.880
August	6.248	6.750	6.056	6.553	21.634	21.628	23.185	23.259
September	6.450	6.890	6.286	6.689	22.050	21.769	23.557	23.589
October	6.500	6.873	6.318	6.674	22.082	21.796	23.226	23.253
November	6.389	6.285	6.222	6.135	21.239	21.469	21.622	21.643
December	6.495	6.250	6.343	6.100	21.342	21.730	21.472	21.484
Year	6.305	6.833	6.131	6.660	21.060	21.271	23.246	23.247

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	New York		London	
	1928	1929	1928	1929
	Straits		Spot	
January	55.650	49.139	253.222	222.727
February	52.440	49.347	233.833	223.138
March	52.220	48.870	232.722	220.781
April	52.270	45.858	234.204	206.887
May	51.582	43.904	230.886	197.545
June	47.938	44.240	217.280	200.206
July	47.040	46.281	212.449	209.473
August	48.012	46.619	212.847	209.815
September	48.073	45.359	215.663	204.863
October	48.966	42.290	222.005	190.783
November	50.750	40.208	232.875	180.565
December	50.185	39.745	227.586	179.419
Year	50.427	45.155	227.131	203.850

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1928	1929	1928 Spot	1928 3 Mos.	1929 Spot	1929 3 Mos.
January	5.643	6.350	26.125	26.051	26.196	26.233
February	5.551	6.350	25.518	25.506	26.247	26.347
March	5.624	6.463	25.082	24.960	27.050	27.294
April	5.759	6.658	25.493	25.316	26.759	26.613
May	6.026	6.618	26.102	25.756	26.727	26.619
June	6.158	6.686	25.664	25.429	26.216	25.984
July	6.201	6.766	24.946	24.972	25.332	25.418
August	6.249	6.800	24.540	24.713	24.896	25.164
September	6.250	6.799	24.497	24.625	24.208	24.688
October	6.250	6.740	24.030	24.296	22.927	23.329
November	6.263	6.242	24.801	24.827	20.851	21.351
December	6.349	5.666	26.609	26.615	20.072	20.672
Year	6.027	6.512	25.284	25.256	24.790	24.976

St. Louis quotations, cents per pound. London pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a)		Quicksilver (b)		Platinum (c)			
					Refined		Crude	
	New York		New York		New York			
	1928	1929	1928	1929	1928	1929	1928	1929
Jan.	10.863	9.558	123.620	119.481	79.280	70.000	69.280	60.000
Feb.	10.842	9.548	121.370	119.818	84.783	70.000	74.783	60.000
March	10.083	9.531	122.557	121.904	80.000	70.000	70.000	60.000
April	9.865	9.462	123.740	122.000	80.000	70.000	70.000	60.000
May	11.019	8.957	123.173	121.154	78.000	68.615	68.000	58.615
June	9.750	8.845	122.423	120.500	78.000	68.000	68.000	58.000
July	9.540	8.543	121.260	121.654	78.000	68.000	68.000	58.000
Aug.	10.181	8.778	124.500	125.111	78.000	68.000	68.000	58.000
Sept.	10.813	8.709	128.000	124.542	78.000	66.000	68.000	56.000
Oct.	10.841	8.538	125.923	124.298	78.000	65.000	68.000	55.000
Nov.	10.109	8.583	123.000	123.323	76.417	65.000	66.418	55.000
Dec.	9.748	8.420	122.500	121.950	74.480	63.240	64.480	53.240
Year	10.305	8.956	123.506	122.145	78.580	67.655	68.580	57.655

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce.

Pig Iron[1] and Aluminum

	Bessemer		Basic		No. 2 Foundry		Aluminum	
	1928	1929	1928	1929	1928	1929	1928	1929
Jan.	17.50	18.00	17.00	17.50	17.25	17.50	24.300	24.300
Feb.	17.50	18.00	17.00	17.50	17.25	17.50	24.300	24.300
March	17.50	18.19	17.00	17.62	17.25	17.69	24.300	24.300
April	17.50	18.50	17.00	18.00	17.25	18.00	24.300	24.300
May	17.37	18.81	16.38	18.31	17.24	18.31	24.300	24.300
June	17.00	19.00	15.56	18.50	16.79	18.50	24.300	24.300
July	17.00	19.00	15.75	18.50	16.69	18.50	24.300	24.300
Aug.	17.00	19.00	15.75	18.50	16.50	18.50	24.300	24.300
Sept.	17.00	19.00	15.75	18.50	16.50	18.50	24.300	24.300
Oct.	17.24	19.00	16.66	18.50	16.74	18.50	24.300	24.300
Nov.	17.82	19.00	17.32	18.50	17.32	18.50	24.300	24.300
Dec.	18.00	19.00	17.50	18.50	17.50	18.50	24.300	24.300
Year	17.37	18.71	16.56	18.20	17.02	18.21	24.300	24.300

Iron in dollars per long ton. Aluminum in cents per pound, 99 per cent grade.

[1]F.o.b. Mahoning and Shenango valley furnaces; freight to Pittsburgh, $1.76.

Monthly Crude Copper Output in Short Tons

		Domestic					
	1928	1929					
	Total	June	July	Aug.	Sept.	Oct.	Nov.
Alaska shipments	22,724	1,793	1,514	893	3,282	1,203	2,079
Calumet & Arizona	65,182	5,286	4,986	5,262	4,926	5,206	4,981
Magma	18,251	1,664	1,616	1,585	1,729	1,660	1,338
Miami	24,129	2,416	1,763	2,317	2,186	3,350	2,882
Nevada Con.	134,231	†36,309	.....	.....	†30,095	.....	.....
Old Dominion*	11,069	782	898	954	932	1,003	1,041
Phelps Dodge††	102,137	8,901	9,274	9,144	9,126	8,534	7,849
United Verde Extens.	22,073	2,510	2,235	2,296	2,570	3,019	2,388
Utah Copper	136,920	†42,310	.....	.....	.....	.....	.....
Tennessee Copper	6,792	638	677	659	660	678	710
		Foreign					
Andes Copper	52,029	6,871	7,445	6,625	6,538	.....	.....
Braden	109,137	7,630	7,620	7,628	7,656	.....	.....
Boleo, Mexico	12,782	†3,637	.....	.....	†3,107	.....	.....
Bwana M'Kubwa	6,696	536	561	593	541	665	.....
Chile	132,932	12,060	11,044	11,042	11,021	.....	.....
Furukawa, Japan	17,865	1,506	1,260	1,425	1,513	1,439	.....
Granby Cons., Canada	28,767	2,518	2,467	2,510	2,718	2,666	2,525
Howe Sound	21,099	†5,452	.....	.....	†5,361	.....	.....
Messina	.....	654	667	657	557	590	.....
Mt. Lyell	6,582	548	600	800	815	.....	.....
Sumitomo, Japan	17,898	.....	.....	1,532	1,352	1,785	.....
Union Miniere, Africa	123,880	12,673	13,216	13,444	14,106	13,995	.....

†Three months. *Includes Arizona Commercial.
††Moctezuma is included.

Monthly Production of Primary Copper from U. S. Mines and Daily Rate (Short Tons)

	1927		1928		1929	
	Monthly Production	Daily Rate	Monthly Production	Daily Rate	Monthly Production	Daily Rate
January	76,198	2,458	68,469	2,209	86,325	2,785
February	69,202	2,472	67,423	2,352	84,735	3,026
March	69,314	2,236	70,327	2,269	93,698	3,023
April	71,122	2,371	69,721	2,324	94,902	3,163
May	71,613	2,310	73,729	2,378	93,392	3,013
June	69,539	2,318	73,224	2,441	82,354	2,745
July	65,545	2,114	73,426	2,369	79,229	2,556
August	67,248	2,169	76,952	2,482	78,885	2,545
September	65,936	2,198	78,341	2,611	79,402	2,647
October	68,545	2,225	86,480	2,790	82,575	2,664
November	68,080	2,269	85,382	2,846	75,231	2,508
December	67,377	2,173	85,677	2,764	.....	.....
Total	829,978	.....	909,051	.....	930,728	.....
Monthly average	69,165	.....	75,754	.....	84,612	.....
Average of daily rate	.....	2,274	.....	2,484	.....	2,787

Mining Stocks—Week Ended December 28, 1929

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda Copper	New York	74⅛	67½	73⅛	Ja 11, Fe 17 Q	1.75
Andes Copper	New York	34⅜	31½	32⅛	Ja 11, Fe 10 Q	0.75
Arizona Commercial	Boston	1⅜	1½	1½	Jl. 16, Jl. 31 SA	0.25
Calumet & Arizona	New York	85½	79½	83⅛	De. 6, De. 23 Q	2.50
Calumet & Hecla	New York	29⅜	27½	28½	No. 30, De. 31 Q	1.50
Cerro de Pasco	New York	65½	58½	63½	Oc. 10, No. 1 Q	1.50
Con. Coppermines	N. Y. Curb	5⅜	5⅛	5⅛		
Copper Range	Boston	15½	14	15	De. 14, Ja. 15 Q	0.50
East Butte	Boston	1⅜	1⅛	1⅛	No. 20, De. 21	0.25
Granby Cons	New York	52⅛	49⅜	49⅜	Oc. 18, No. 1 Q	2.00
Greene Cananea	New York			112	De. 12, Ja. 6 Q	2.00
Howe Sound	New York	38⅜	37⅛	38	De.31,Ja.15 QX	1.50
Hudson Bay	N. Y. Curb	8⅜	8⅛	8⅛		
Inspiration	New York	27⅛	25⅜	26⅛	De. 19, Ja. 6 Q	1.00
Isle Royale	Boston	13	10	12½	No. 30, De. 31 Q	0.50
Kennecott	New York	58⅛	54½	58⅛	No. 29, Ja. 2 Q	1.25
Magma Copper	New York	51	46	48⅜	De. 30, Ja. 15 Q	1.25
Mason Valley	N. Y. Curb	2	2	2		
Miami Copper	New York	27	25	26	No. 1, No. 15 Q	1.00
Mohawk	Boston	44	43⅛	43⅛	Oc. 3, De. 2	3.00
Mother Lode	New York	2	1½	1⅜	De. 9, De. 31	0.20
Nevada Cons	New York	30¼	26⅛	28½	De. 13, De. 31 Q	0.75
Noranda	N. Y. Curb	34	32½	33	De. 10, Ja. 2 Q	0.75
Ohio Copper	N. Y. Curb	1½	1	1⅛	Sept. 1926	0.03
Old Dominion	Boston	7	6½	6½	Dec. 1918	1.00
Phelps Dodge	New York	40⅛	38½	39	De. 6, Ja. 2 Q	0.75
Quincy	Boston	19	17	18⅜	March, 1920	1.00
Roan Antelope	N. Y. Curb	26½	25	25		
St. Mary's M. L.	Boston	25½	24	25	No. 29, De. 10	1.00
Seneca Copper	New York	2⅜	2½	2½		
Shattuck Denn	N. Y. Curb	8⅜	8⅜	8⅜		
Sherritt-Gordon	Toronto	3.15	2.76	3.15		
Tenn. C. & C	New York	13½	12	13	No. 30, De. 16 Q	0.25
United Verde Ex	N. Y. Curb	12⅞	12½	12⅜	Ja. 2, Fe. 1 Q	1.00
Utah Copper	New York	240	230	240	De.13,De.31 QX	8.00
Waite-Ack.-Mont	Toronto	3.25	3.25	3.25		
Walker Mining	Salt Lake	4.50	4.50	4.35		
Nevada Copper	N. Y. Curb	*75	*56½	*75		
LEAD, ZINC, SILVER						
Ahumada Lead	New York	*62½	*37½	*37½		
Amer. Z., L. & S.	New York	9⅜	8	8½	May, 1917	1.00
Amer. Z., L. & S. pfd.	New York	55	52½	53½	De. 12, Ja. 1 Q	1.50
Bunker Hill & S.	N. Y. Curb	101	98	98	No. 29, De. 5 X	0.50
Butte Cop. & Z.	New York	3⅛	2⅛	2⅛	De. 10, De. 25	0.50
Butte Cop. Con	Boston Curb			31½		
Butte & Sup.	New York	5⅛	4⅜	4⅜	De. 13, De. 31 Q	0.50
Callahan Zn.-Ld.	New York	1⅛	1	1	De. 1920	0.50
Chief. Cons.	Salt Lake	1.85	1.82½	1.82½	Fe. 1, 1918 K	0.10
Cons. Ld. & Zn. "A"	St. Louis	5⅛	5⅛	5⅛	Jan. 1930 Q	0.12½
Constitution	Spokane	*32	*31½	*32		
Dayrock	Spokane	2.00	1.80	2.00	Je. 20, Je. 30	0.03
Dickens Consol	Spokane	*3½	*2⅜	*2⅜		
Eagle-Picher	Cincinnati	13⅜	12⅜	13	De. 31, Ja. 15 Q	0.20
Eagle-Picher, pfd.	Cincinnati			101	De. 31, Ja. 15 Q	1.50
Erupcion	Boston Curb			†*6½	Jan. 1, 1928	0.07½
Eureka Bullion	Salt Lake	*45	*40	*42½		
Eureka Lily	Salt Lake			36½		
Evans-Wallower	N. Y. Curb	4⅛	3⅛	3⅛		
Evans-Wal., pfd.	N. Y. Curb			80	De.20, Ja.1 Q	1.75
Federal M. & S.	New York			195	June, 1927	10.00
Fed. M. & S., pfd.	New York	96⅛	96	96⅛	No. 25, De.16 Q	1.75
Gladstone	Spokane			*1⅛		
Golconda	Spokane	*79	*74⅛	*78⅛	Je. 15, Jl. 1	0.02
Grandview	Spokane	*14⅛	*12⅜	*14⅛		
Hecla Mining	N. Y. Curb	12⅞	12⅛	12⅛	No. 15, De. 15 Q	0.25
Highland-Surprise	Spokane	*7	*6	*6⅛		
Jack Waite	Spokane	*6⅞	*6⅛	*6⅛		
Kootenay Florence	Spokane	*6⅛	*6⅛	*6⅛		
Lucky Jim	Spokane	*6⅛	*6⅛	*6⅛		
Lucky Tiger-C	Kansas City			†2.25	No. 9, No. 20 M	0.02½
Mexican Premier	Spokane	1.99	1.94	1.98	Ja. 15, Ja. 30	0.01
National Lead	New York	138	134	138	De. 13, De. 31 Q	1.25
Natl. Lead, pfd. A	New York	138½	138	138	Nv.29, De.14 Q	1.75
Natl. Lead, pfd. B	New York	117	116½	117	Jc. 17, Fe. 1 Q	1.50
N. J. Zinc, new	N. Y. Curb	67	65⅛	66	Ja.20, Fe. 10 Q	0.50
New Quincy	Salt Lake	1.20	1.07½	1.20	Se. 20, Se. 30 Q	0.10
Noble Five	Spokane	*39	*37	*38		
North Lily	Salt Lake	2.75	2.32½	2.32½	Oc. 16, Oc. 23	0.25
Park Bingham	Salt Lake	5.50	5.50	5.50		
Park City Con	Salt Lake	3⅛	3	3		
Park Utah	New York	3⅜	3⅛	3⅛	Dividends suspended	
Pend Oreille	Spokane	2.40	2.00	2.40		
Rico Argentine	Salt Lake			*15⅛	No. 30, De. 15 Q	0.03
Ruth-Hope	Spokane	*22	*18	*19⅛		
St. Joseph Lead	New York	50½	47⅛	48⅛	Se. 10, Se. 20 QX	0.75
Sherman Lead	Spokane	*70	*55	*70		
Silver King Coa	Salt Lake	10.25	10.25	10.25	De.15, Ja.2 QX	0.45
Silversmith	Spokane	*6	*5⅛	*5⅛	Oct., 1926	0.02
Sunshine Mining	Spokane	4.85	4.70	4.75	De. 10, De. 20 Q	0.08
Tamarack-Custer	Spokane	*48	*44	*47	Sept., 1924	0.25
Tintic Standard	Salt Lake	10.50	10.25	10.50	Se. 17, Se. 20 X	0.30
Tonopah Belmont	N. Y. Curb			*43⅛	Oct., 1925	0.05
Treadwell-Yukon	Toronto	8.00	7.50	8.00		
United Zinc Smg. New	N. Y. Curb			7		
Utah Apex	Boston	3	2⅜	2⅜	Oc. 15, No. 1	0.25
Utah Met. & Tun	Boston	*70	*62	*62	Dec., 1927	0.30
Whitewater	Spokane			*16		
Yellow Pine	Los Angeles			*8	Dec., 1925	0.04
GOLD						
Alaska Juneau	New York	7⅛	6⅞	7		
Barry-Hollinger	Toronto	*16	*14	*14⅛		
Central Manitoba	Toronto	*20	*20	*20		
Cresson Consol	N. Y. Curb	*37⅛	*25	*25	De. 31, Ja. 27 Q	0.025
Dome Mines	New York	7	6⅜	6⅜	De. 31, Ja. 20 Q	0.25
Golden Cycle	Col. Springs	†15	†14		No. 30, De. 10	0.40
Hollinger	Toronto	5.05	4.95	4.95	De.13, De.31 FW	0.05
Homestake	New York	80	0	80	De.20, De.26 M	0.50
Kirkland Lake	Toronto	*50	*39½	*47		
Lake Shore	Toronto	19.50	19.25	19.25	De.2, De.16 Q	0.30
McIntyre Porcupine	New York	15	15	15	Nv. 1, De. 2 Q	0.25
Portland	Col. Springs	†*6	†*4⅛		April, 1927	0.01
Rand Mines	New York			25	Au.21, 29 A.s.	1.50
Siscoe	Toronto	*44	*40	*42		
Sylvanite	Toronto	*45	*40	*45		
Teck-Hughes	Toronto	5.05	4.80	5.00	Ja. 17, Fe. 1 Q	0.15
Tom Reed	Los Angeles	*55	*50	*52	Dec., 1926	0.02
Unity Gold	N. Y. Curb	*50	*43⅜	*43⅜		
Vipond Consol	Toronto	*67	*64	*67	April, 1927	0.03
Wright-Hargreaves	Toronto	1.30	1.27	1.30	Oc. 16, No. 1	0.02½
Yukon-Alaska	N. Y. Curb			35⅜		
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	6⅛	5⅜	6		
Castle-Trethewey	Toronto	*22	*22	*22		
Consol. Cortes	N. Y. Curb	*6½	*6½	*6½		
Dolores Esperanza	N. Y. Curb	*12⅛	*6½	*12⅛	July, 1923	0.05
Keeley	Toronto			*33	Mr. 15, 1928	0.04
Mining Corp	Toronto	3.00	2.90	2.99	De. 4, De. 19	0.12½
Montana-Mines Corp.	Spokane	*42	*34½	*42		
N. Y. & Hond. Ros	N. Y. Curb			16	De.18, De.28 X	0.50
Nipissing	N. Y. Curb	1⅜	1⅛	1⅛	De. 31, Ja. 20 Q	0.07½
Premier Gold	N. Y. Curb	1⅛	1⅛	1⅛	De. 11, Ja. 4 Q	0.06
Tonopah Exten	N. Y. Curb			*10	April, 1925	0.05
Tonopah Mining	N. Y. Curb			2⅛	Se. 30, Oc. 21	0.07½
United Eastern	N. Y. Curb			*18⅛		
Yukon Gold	N. Y. Curb	*56⅛	*50	*56⅛	June, 1918	0.02
IRON AND STEEL						
Bethlehem Steel	New York	93⅜	86½	91½	Jan. 18, Fe. 15 Q	1.50
Beth. Steel, pfd, 7%...	New York	123½	122½	122⅜	De. 7, Ja. 2 Q	1.75
Cleveland-Cliffs	Cleveland	94	92½	94	De.10, De.20 Q	1.00
Colo. Fuel & Iron	New York	36½	32⅛	34⅜		
Colo. F. & I., 1st pfd	New York			126	No. 10, No. 1 Q	2.00
Great Northern Iron	New York	20⅜	19½	20½	Dec. 15 K	2.00
Inland Steel	New York	73	71	73	No. 15, De. 1 Q	0.87½
Republic I. & S.	New York	78⅛	70⅛	72⅛	No. 12, De. 2 Q	1.00
Republic I. & S. pfd.	New York	107⅛	107	107⅛	De. 12, Ja. 2 Q	1.75
Sloss-Sheffield S. & I.	New York	35	35	35	Mr. 11, Mr. 20Q	1.50
Sloss-Sheff. S.&I., pfd.	New York	80	79½	80	De. 20, Ja. 2 Q	1.75
U. S. Steel	New York	169½	156⅛	164½	No.30, De.30 QX	2.75
U. S. Steel, pfd.	New York	141½	140⅜	141½	No. 2, No. 29 Q	1.75
Virginia I. C. & C.	New York	13	13	13	Jan., 1924	1.50
Virginia I.C.&C., pfd.	New York	39	39	39	Jl. 16, 1928 SA	2.50
MISCELLANEOUS						
Aluminum Co. of Am.	N. Y. Curb	304½	290	304½		
Alum. Co. of Amer., pf.	N. Y. Curb	109	108½	108⅜	De. 14, Ja. 1 Q	1.50
American Metal	New York	47½	42	45	No. 20, De.2 Q	0.75
Amer. Metal, pfd., 6%	New York	112⅜	112⅛	112⅛	No. 20, De.2 Q	1.50
Amer. Sm. & Ref.	New York	73⅛	67⅛	72⅛	Oc. 11, No. 1 Q	1.00
Amer. Sm. & Ref., pfd.	New York	134	134	134	No 1, De. 2 Q	1.75
Ang. Ch. Nitrate	N. Y. Curb	19	18	18⅛		
Asbestos Corp.	Montreal			2⅛	Jan., 1926	1.50
Asbestos Corp., pfd.	Montreal			12	De. 31, Ja. 15 Q	1.75
Consol. M. & S.	Montreal	255	250	250	De. 31, Ja. 15 X	6.25
De Beers Consol	New York	14	14	14	Jl. 23, Jl. 26 Q	0.96
Federated Metals	N. Y. Curb	23⅛	23⅛	23⅛	De.20,De. 30 QX	0.50
Freeport Texas	New York	39⅜	35⅜	37⅜	Oc. 15, No. 1 Q	1.00
Int. Nickel Can.	New York	31⅛	28⅜	30⅜	No. 30, De. 31 Q	0.25
Int. Nickel, pfd.	New York			118	De. 28, Fe 1 Q	1.75
Mayflower Assoc	N. Y. Curb	49	47⅛	47⅛		
Metal & Mining	N. Y. Curb	9⅞	8⅛	9⅛	De. 31, Ja. 2	0.30
Newmont	N. Y. Curb	115⅛	101⅛	101⅛	De. 27, Ja. 15 Q	1.00
Patino M. & E.	New York	28	27⅛	27⅛	De. 7, De. 24	4s.
So. America G. & P.	N. Y. Curb	1⅜	1⅛	1⅛		
Texas Gulf Sulphur	New York			53½	De. 2, De. 16 Q	1.00
U. S. Sm. R. & M.	New York	37⅛	34⅛	35	De. 31, Ja. 5 Q	0.87½
U. S. Sm. R. & M., pfd	New York	53⅛	52⅜	52⅜	De. 31, Ja. 5 Q	0.87½
Vanadium Corp	New York	50⅜	45⅛	48⅛	Nv.1, Dc.16 QX	1.75

Toronto Standard Stock Exchange, Toronto, courtesy the Arthur E. Moysey Co.; Salt Lake Stock Exchange, courtesy J. A. Hogle & Co. and Logan & Bryan, New York; Standard Stock Exchange, Spokane, courtesy Pohlman Investment Company

*Cents per share. †Bid—asked range. Q, Quarterly. A. Annually. SA, Semi-annually. M, Monthly. BM, Bimonthly. FW, Four weeks. K, Irregular. I Initial. R, Respumption. X, Extra. The first date given is that of the closing of the books; the second that of the payment of the dividend. A.s., American shares.

LONDON QUOTATIONS—WEEK ENDED December 16 1929

	High	Low	Last	Date	Amount
Alaska Mexican ($5)	12/6	12/6	12/6		
Alaska Treadwell ($25)	60/—	60/—	60/—	Nov., 1926	4 p.c.
Aramayo Mines (25 frs.)	47/6	43/9	45/—	Nov., 1929	5 p.c.
Burma Corpn. (10 rupees)	16/10½	16/4½	16/9	Feb., 1930	7 annas*
Bwana M'Kubwa (5s)	21/10½	20/3	20/9		
Camp Bird (2s)	1/6	1/1½	1/4½	April, 1928	16⅔ p.c.
El Oro (5s)	2/6	2/—	2/6	Nov., 1929	20⅔ p.c.
Frontino & Bolivia (£1)	7/9	7/9	7/9	Jan., 1929	3⅓ p.c.
Mexican Corpn. (£1)	11/6	11/6	11/6	Oct., 1929	10 p.c.
Mexico Mines of El Oro (£1)	3/9	2/6	3/1½	Dec., 1926	3⅓ p.c.*
Mount Isa (£1)	26/6	25/7½	26/3		
N'Changa Copper Mining (£1)	37/9	35/—	36/3		
Oroville Dredging (4s)	1/7½	1/7½	1/7½	Nov., 1928	31½ p.c.
Rhodesian Congo Border (£1)	137/6	133/9	135/—		
St. John del Rey (£1)	17/3	17/—	17/—	Dec., 1929	2½ p.c.
San Francisco Mines (10s)	28/4½	27/10½	28/4½	June, 1929	15 p.c.
Santa Gertrudis (£1)	12/6	11/9	12/6	Jan., 1930	7½ p.c.
Selukwe (2s. 6d.)	4/3½	3/8	4/—	April, 1917	6⅔ p.c.
S. Amer. Copper (2s)	1/7½	1/3	1/6	Nov., 1917	75 p.c.
Tanganyika (£1)	46/3	39/6	40/—	July, 1929	7½ p.c.
Union Miniere du Haut-Katanga (Brussels)	9,600	9,050	9,050	April, 1929	300 fr. (‡)

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian francs and free of taxation.